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ABSTRACT

In the early 1990s, staff from the National Center for Improving Science Education (NCISE), the various Department of Education (DOE) National Laboratories, and the DOE's Office of Science Education Programs embarked on a 5-year project to develop a process to document what programs the National Laboratories were offering for teachers and students, and to ensure that these programs were operated effectively and led to desired outcomes. This book extends this work by describing the program improvement process. The components of four types of programs are described: (1) teacher development; (2) teacher research; (3) student enrichment; and (4) systemic programs, all based on research and the accumulated experience of expert practitioners. Profiling program quality in action is also illustrated through examples from actual teacher development, teacher research, student enrichment, and systemic programs. (Contains 41 references.) (ASK)

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Enhancing Program Quality in Science and Mathematics

Joyce S. Kaser

Patricia S. Bourexis

With

Susan Loucks-Horsley • Senta A. Raizen

THE NETWORK

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THE NETWORK

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Preface

Virtually every school and district in the United States is engaged in science and mathematics education reform. Partnerships among schools, universities, states, private organizations, and the federal government promote this reform. Programs that promise to support improved science and mathematics instruction are operating in thousands of communities.

The National Center for Improving Science Education (NCISE [pronounced en-cize]) is a frequent and willing partner in many of these programs—particularly ones built on teacher development and research, student enrichment, and systemic strategies. *Enhancing Program Quality in Science and Mathematics* is an outgrowth of NCISE's most recent effort.

In the early 1990s, staff from NCISE, the various U.S. Department of Energy (DOE) National Laboratories, and the DOE's Office of Science Education Programs (OSEP) embarked on a 5-year project to develop a process to (a) document what programs the National Laboratories were offering for teachers and students and (b) ensure that these programs were operated effectively and led to desired outcomes. Eventually, science and mathematics program directors in more than 50 local settings and staffs from several federal agencies and consulting firms lent their insights and experiences.

In the course of this effort, we discovered that programs that were most effective in promoting sound science and mathematics education for all students had common characteristics. They reflected the best of what we know from research and the experience of expert practitioners about professional development, instruction, and learning. Program directors and staff from settings outside the National Laboratories confirmed our discovery. Furthermore, when directors and staffs modified and refined their programs to reflect what we know from research and experience, the outcomes of their programs improved.

These insights spurred us to extend our work with the DOE and the National Laboratories by describing this continuous program improvement process in ways we hope are useful to program directors, staffs, sponsors, and communities across the country. That is the purpose of this book.

We call this improvement philosophy *profiling program quality.* It recognizes that effective programs supporting better science and mathematics education do not spring forth quickly, but rather evolve from careful examination and improvement over time. *Profiling program quality* gives directors, staffs, sponsors, and communities a way to watch over a program during development and to help guide the program toward success.

More specifically, this book is designed to do the following:

- Engage program directors, staffs, sponsors, and communities in fruitful dialogues about the significant role that *teacher development, teacher research, student enrichment,* and *systemic programs* play in improving science and mathematics education for all students
- Describe the components of these four types of programs based on research and the accumulated experience of expert practitioners
- Provide the means and technology for program directors and staffs to ensure the quality of their efforts, investigate outcomes, and take corrective actions when necessary
- Illustrate *profiling program quality* in action through examples from actual teacher development, teacher research, student enrichment, and systemic programs
- Build a common understanding of program outcomes, expectations, and values
- Point program directors and staffs toward the research literature and resources for further examination and assistance

The primary audience for this book is people who direct or may direct teacher development, teacher research, student enrichment, or systemic programs intended to improve science and mathematics education, and their staffs. These individuals work in schools, school districts, and regional and state education agencies, as well as in colleges and universities and private organizations. All are partners in science and mathematics reform. A secondary but equally important audience is program sponsors—principals, superintendents, boards of education, other policymakers, and funders who are accountable to the community for program outcomes and who make the efforts possible through their involvement and support.

NCISE remains committed to helping program directors, staffs, sponsors, and communities realize all the possible benefits from programs supporting improved science and mathematics education. This book exemplifies NCISE's commitment to bridge the gaps among research, practice, and policy and to promote cooperation and collaboration among organizations, institutions, and individuals committed to science and mathematics reform.

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Enhancing Program Quality in Science and Mathematics is an outgrowth of the National Center for Improving Science Education's (NCISE) work with the Office of Science Education Programs (OSEP) of the U.S. Department of Energy (DOE). We wish to extend our appreciation to Margaret Dwyer and the OSEP staff for their commitment to excellence in science and mathematics education and the role the National Laboratories play in this national effort. This was truly a collaborative effort, with program directors and staffs from many of the National Laboratories, and would not have happened without their vision and leadership.

We also thank Ted Britton (NCISE) for his dedication to getting this book published and to LaDonna Dickerson (NCISE) for her assistance in preparing the manuscript. Both made invaluable contributions. The following individuals reviewed this manuscript and provided helpful feedback: Cathy Bullock, Karen Charles, Francina Cummings, Maria Found, Diane Holden, Rene Parmar, Anne Grall Reichel, Dorothy E. Williams, and Marsha Winegarner. We gratefully acknowledge their time and contributions.

About the Authors

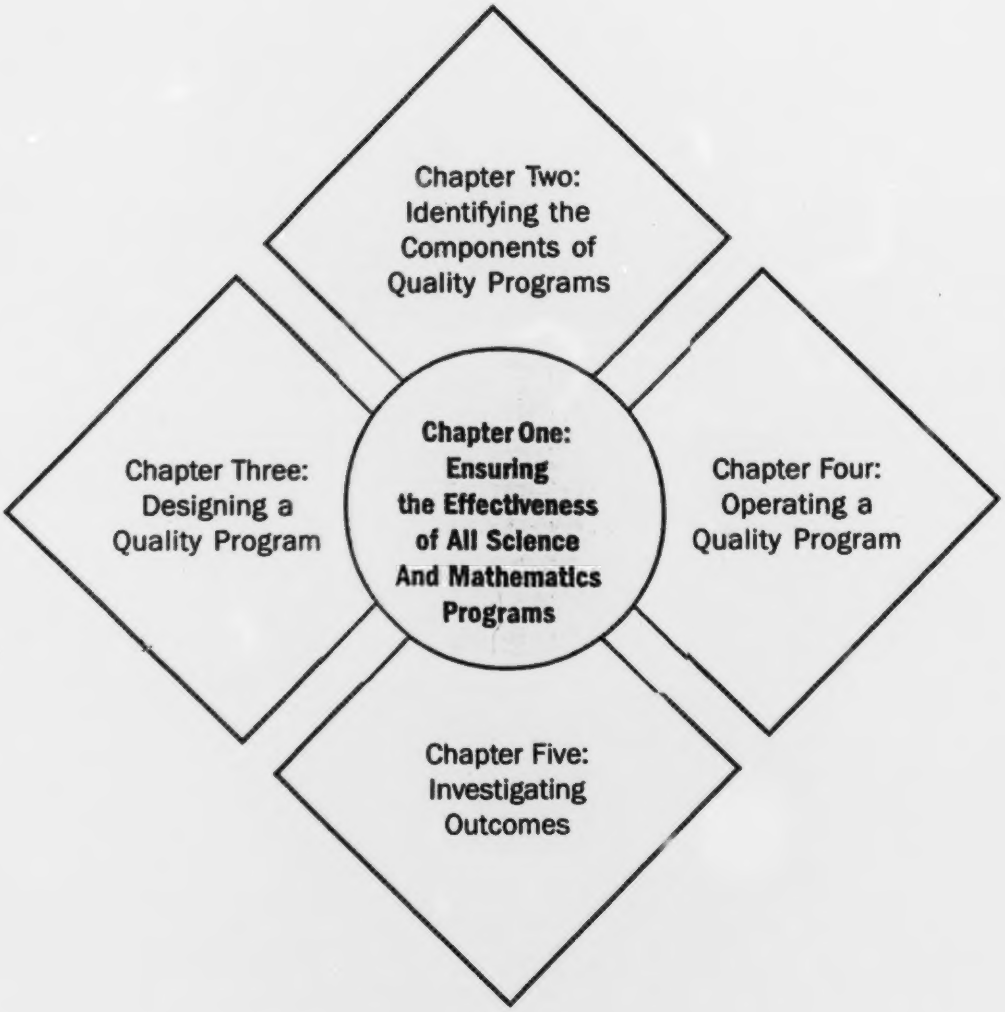
Joyce S. Kaser (EdD, American University, Washington, DC), President of Kaser and Associates, played a major role in developing the approach to strengthening mathematics and science programs described in this book. In the early to mid-1990s, she was a member of the National Center for Improving Science Education (NCISE) team that worked with the U.S. Department of Energy (DOE) to develop an approach to formative evaluation of the DOE's educational programs. She was senior author of several reports written over the life of the project, the lead developer of a training manual to assist in implementing new processes within the DOE (*Using a Profiling Process to Ensure Program Quality*), and author of a chapter describing the project in *A User's Guide to Program Templates: A New Tool for Evaluating Program Content*. She has also been an evaluator of state, urban, and local systemic change efforts, along with numerous national and statewide professional development programs. A former teacher and school administrator, she is coauthor of a change management methodology for use in education, along with a risk analysis assessment process for large system interventions.

Patricia S. Bourexis (MS, Johns Hopkins University; PhD, Syracuse University) is President of The Study Group Inc., an education research organization that specializes in helping clients achieve their long-term goals to improve education. She is currently working with several federal agencies and private organizations in strategic planning, consumer outreach, and program evaluation. Her interest in program evaluation as a reflective management tool began with her tenure as Program Administrator of the

Evaluation Research Center at the University of Virginia in the early 1970s. Since then, she has used various approaches to program evaluation to help education program managers and staffs assess and improve the outcomes of their work. A former high school mathematics and physics teacher, she has a long-standing interest in the quality of science and mathematics education, particularly for young women and minorities. In the 1980s, she was President and Chief Executive Officer of Systems Impact, Inc., a private corporation pioneering the application of videodisc technology to science and mathematics instruction. She also served on the staff of Project 2061 at the American Association for the Advancement of Science (AAAS), working with school districts to develop frameworks for effective science and mathematics education. A frequent collaborator with NCISE on science and mathematics reform efforts, she helped NCISE and the DOE translate the methodology described in this book for use by education program managers, staffs, and sponsors nationwide. Her MS is in numerical science; her PhD is in special education policy and administration.

Susan Loucks-Horsley (PhD, University of Texas at Austin) is Director of the Professional Development Project of the National Institute for Science Education (NISE); Director of Professional Development and Outreach at the National Research Council's (NRC) Center for Science, Mathematics, and Engineering Education; and Program Director for Science and Mathematics at WestEd. Her work at NISE examines effective practice in professional development, both in-service and pre-service. At the NRC, her primary work is promoting, supporting, and monitoring the progress of standards-based education, especially the *National Science Education Standards*. At WestEd, she works with projects evaluating and assisting in mathematics and science education reform. She is senior author of *Designing Professional Development for Teachers of Science and Mathematics, An Action Guide for School Improvement, Elementary School Science for the 90s,* reports from NCISE on teacher development and support, and numerous chapters and articles on related topics. While at the University of Texas at Austin Research and Development Center for Teacher Education, she helped develop the concerns-based adoption model, which describes how individuals experience change.

Senta A. Raizen, Director of the National Center for Improving Science Education (NCISE)/WestEd, is responsible for NCISE's overall direction and its work in evaluation. She has led several major evaluation efforts, including formative evaluation of the DOE's educational programs and evaluation of federally sponsored programs that provide professional development for science and mathematics teachers. She is the lead author of several NCISE reports on science education in elementary, middle, and high school. Her recent books include *A Splintered Vision: An Investigation of U.S. Science and Mathematics Education* (coauthor) for the Third International Mathematics and Science Study (TIMSS); *Bold Ventures,* a three-volume series of case studies of mathematics and science innovations in the United States; *The Future of Science in Elementary Schools: Educating Prospective Teachers;* and *Technology Education in the Classroom: Understanding the Designed World.* She holds college and advanced degrees in chemistry and began her career as an industrial chemist; she also is certified as a high school chemistry teacher. She is a fellow of the American Association for the Advancement of Science (AAAS) and a member of the American Educational Research Association (AERA). She serves in an advisory capacity for several national and international education studies, including the National Assessment of Educational Progress (NAEP), the National Educational Longitudinal Study of 1988 (NELS: 88), and the National Goals Panel. She is a member of the International Steering Committee of TIMSS and of the Science Functional Expert Group for the OECD's international literacy assessment of 15-year-olds.


Chapter Two: Identifying the Components of Quality Programs
Chapter Three: Designing a Quality Program
Chapter One: Ensuring the Effectiveness of All Science And Mathematics Programs
Chapter Four: Operating a Quality Program
Chapter Five: Investigating Outcomes

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Ensuring the Effectiveness of All Science and Mathematics Programs

WHY SHOULD WE ENSURE THAT ALL PROGRAMS SUPPORTING SCIENCE AND MATHEMATICS EDUCATION ARE EFFECTIVE?

The nation is demanding improved science and mathematics education for all students. Significant investments of time, energy, and resources are being made in a variety of programs that aim to support improvements in science and mathematics education. How good are these programs? Are the resources being invested wisely? What adjustments could be made to better use the available resources, and as resources shrink, how should the choices be made?

As educators, we have a collective responsibility to make sound resource investments in programs that deliver on their promises. We no longer have the luxury of investing in programs that may or may not be effective. Finding that programs fall short of our expectations when evaluated after several years and expenditures of several thousands of dollars is unacceptable.

Central to quality assurance is knowledge about what constitutes a quality program. If we know what factors must be in place to ensure a program's success—and build these factors into the program's design and operations—we are more likely to have an effective program.

During the past few years, we have seen an increasing concern for identifying key factors for success. For example, *subject matter standards*—sets of criteria about what students should know and be able to do at certain grade levels—have been published in education. Mathematics standards came from the National Council of Teachers of Mathematics (NCTM, 1991); science standards came from the National Research Council (NRC, 1996) of the National Academy of Sciences. Both are supported by the work of Project 2061 of the American Association for the Advancement of Science (AAAS, 1993). Such standards are necessary if all students are to acquire the knowledge and skills they need to be effective adults. Students in one class in a school need to reach similar levels of mathematical and scientific understanding as students in classes down the hall. Students in one district need to acquire the same knowledge and skills as students in other districts within a state. Regardless of where they live or go to school, students need to reach a specified level of achievement before graduating from high school.

In addition to specifying what students should know and be able to do, the national standards include criteria on pedagogy, assessment, and professional development for teachers. Stressing what students need to know without identifying what teachers need to know and do to teach them is incomplete. If teachers do not do anything differently in the classrooms, then student achievement is unlikely to change. In fact, standards are needed for all components of the educational enterprise.

WHAT TYPES OF PROGRAMS ARE WE TALKING ABOUT?

This book focuses on four types of programs that support improvements in science and mathematics education for all students:

1. Teacher development programs
2. Teacher research programs
3. Student enrichment programs
4. Systemic programs

These programs are operating in thousands of colleges and universities, private organizations, schools, and communities across the country as strategies to improve classroom instruction and student achievement in science and mathematics. The types are distinguished by their goals, participants, activities, and anticipated outcomes. All are intended to influence and support classroom instruction and student achievement.

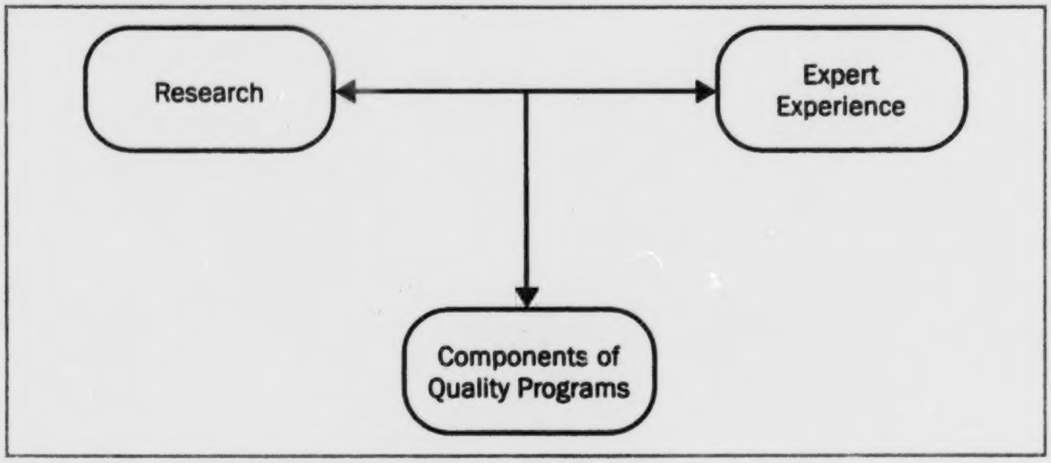

Figure 1.1 Sources of Components of Quality Programs

Although NCISE's work has focused on these four types of programs, the approach to strengthening their effectiveness is applicable to many other support programs. These can be programs oriented toward subjects other than mathematics and science or programs that are planned and operated somewhat differently. In some cases, the approach applies without adaptation; in others, adaptations are necessary.

WHAT MAKES A QUALITY PROGRAM?

Quality programs are designed and carried out by using what we know from research and experience. They yield stronger outcomes for schools, teachers, students, and communities. Quality programs use a common knowledge base while adapting to their host environments and conditions in truly innovative and thoughtful ways. As the research base expands and our experience deepens, we modify programs in response. This is innovation. But in all cases, quality stems from the program's reliance on research and expert experience as we know them.

NCISE, together with program directors and sponsors of science and mathematics programs at all levels of responsibility—from national to local communities—read, evaluated, interpreted, and summarized research and expert experience related to quality teacher development, teacher research, student enrichment, and systemic programs. We found that programs that lead to strong, significant outcomes supporting improved mathematics and science education for all students have several common components (see Figure 1.1). These components functioned repeatedly in different program forms and in different environments with the same, sound outcomes. The

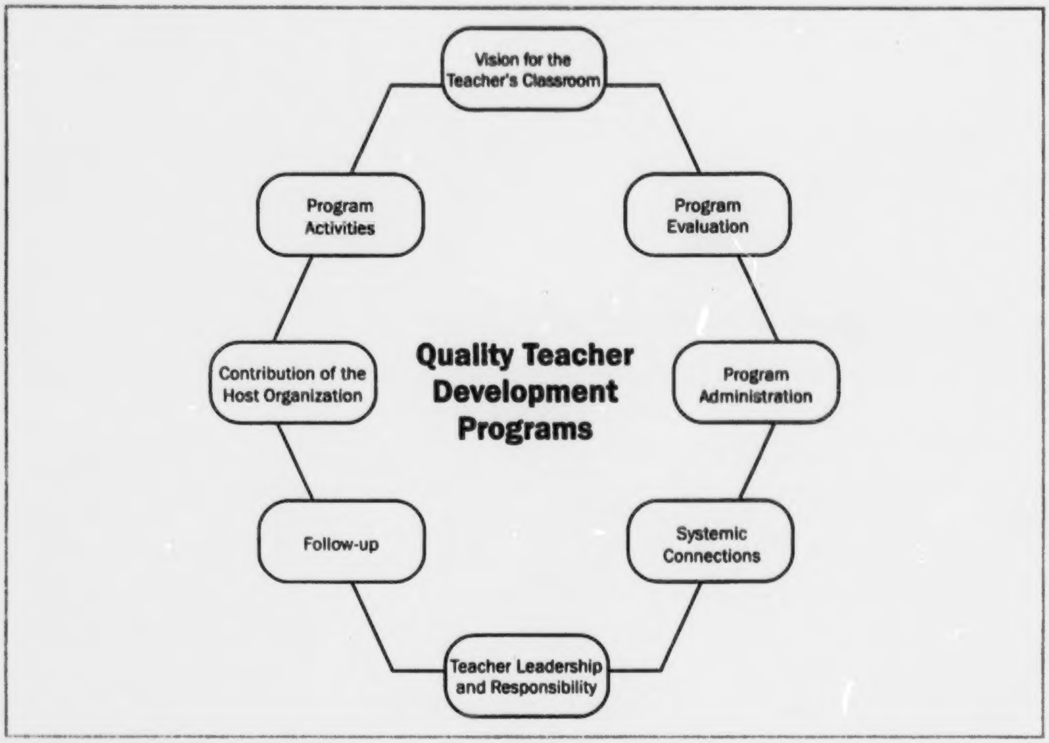
Vision for the Teacher's Classroom
Program Activities
Program Evaluation
Contribution of the Host Organization
Quality Teacher Development Programs
Program Administration
Follow-up
Systemic Connections
Teacher Leadership and Responsibility

Figure 1.2 Components of Quality Teacher Development Programs

components are reflected in the program's design and operation. As the program develops over time, the components become stronger and more focused.

Some components are present in all four types of programs; some are specific to a type of program. For example, *evaluation* is a component common to all programs. Evaluation is of three types: monitoring, refining program operations based on progress, and investigating outcomes. *Mentor assignments and role* is a component specific to teacher research programs.

Some program types—namely, systemic programs—have not been studied carefully to date, so their components are based more on the expert experience of program directors and sponsors than on research. Wherever possible, we tested the components ourselves with existing programs before including them as those linked to program quality.

In all cases, we found that the components combine in a program's design and operation to produce results; their presence and influence ensure a quality program. Research and experience tell us that when all the necessary program components are present, focused, and strong, the program will be most effective. Figure 1.2 illustrates the crucial combination of components in a quality teacher development program. Chapter 2 describes the components of quality teacher development, teacher research, student enrichment, and systemic programs.

HOW DO WE STRENGTHEN PROGRAM QUALITY?

We developed an approach to planning, operating, and managing programs that supports science and mathematics education. This approach enables program directors, sponsors, and communities to strengthen these programs' effectiveness continuously in supporting science and mathematics education. The approach is *profiling program quality.*

The approach traces its origins back 15 years to research done by Susan Loucks-Horsley and her colleagues at the University of Texas Research and Development Center for Teacher Education; it was further developed through the collaborative work of the U.S. Department of Energy (DOE) and the National Center for Improving Science Education (NCISE). We refined the methodology over the years, including major changes stemming from our recent collaboration with program directors and sponsors across the country.

The approach begins with translating the research and expert experience knowledge bases into a set of components found to be associated with quality programs. We have done this for the types of mathematics and science support programs used throughout this book as examples. Then the program is *consciously* designed around these components. This can be more difficult than it sounds. Program directors and sponsors must avoid "playing hunches" or jumping on the latest educational fad. They must deal in a disciplined way with what we know from research and expert experience.

Program directors, sponsors, and communities monitor a program's design and operation by tracking the presence and contribution of each component of program quality. On the basis of their findings, they refine the program's design and operations to strengthen continuously and take full advantage of the contribution made by each component.

Why speak of a profile? Because the combination of components of quality programs that support science and mathematics education gives these programs a certain definition, outline, shape, or contour. This is what distinguishes them from less effective programs. *Profile* is the term we use to describe the particular shape of a quality program, which comes from its combination of its components.

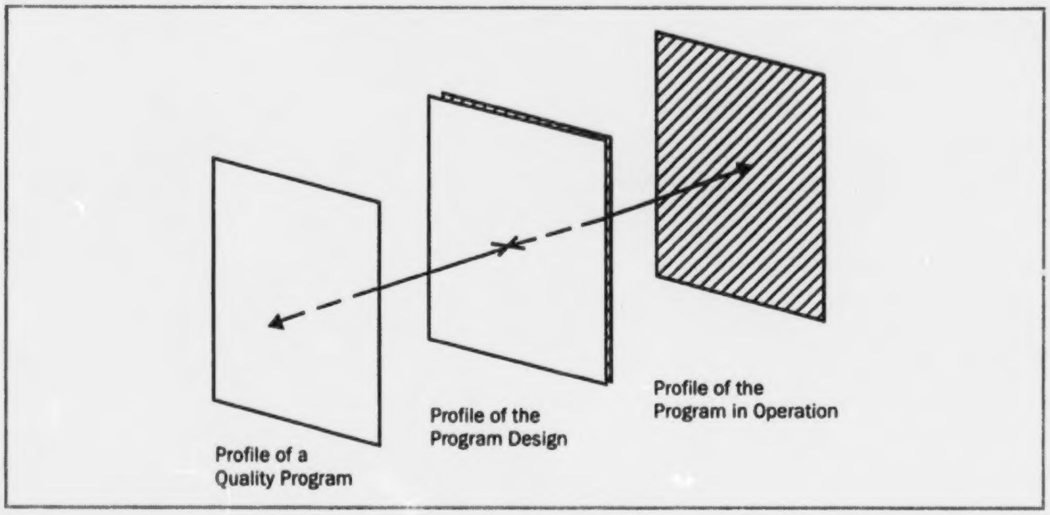

Figure 1.3 Enhancing Program Quality Emphasizes Improvement Toward an Ideal

WHAT IS PROFILING PROGRAM QUALITY?

Profiling program quality is a process that engages program directors, sponsors, and communities in constantly doing the following:

1. Comparing a program's design and actual operations to the components of quality programs
2. Pinpointing components that are performing well and those that are absent or weak, and then
3. Consciously making changes in the program's design and operations that strengthen the performance of each component

Profiling program quality is a process, not an event. It is a philosophy of program management that emphasizes constant improvement toward an ideal (see Figure 1.3). The ideal is a program that mirrors completely the profile of a quality program; that is, it reflects all the program components that research and expert experience tell us are essential to maximize outcomes.

Profiling program quality does not take the place of the traditional management and supervisory activities such as budgeting, planning, monitoring, evaluating, and reporting. It integrates these into a broader context in the light of what we know to be true about quality programs. It is unique because it is driven by research and expert experience.

Profiling program quality gives directors, sponsors, and communities a common understanding of a program's potential for success and ways to increase this potential. Followed consistently, programs reflect, over time, the profile of a truly quality program: They function most effectively and lead to improvements in science and mathematics instruction and achievement.

Profiling program quality has three stages. Chapters 3 through 5 in this book explain each stage: (a) designing an effective program, (b) operating an effective program, and (c) investigating outcomes. They also include formats and procedures that program directors can use to profile the quality of their own teacher development, teacher research, student enrichment, and systemic programs.

Stage 1: Designing a Quality Program

Program directors and sponsors begin Stage 1 by comparing the components of their own program's initial design with each component of a quality program of that type. For a teacher development program, for example, this means comparing the program design with the following components: *vision for the teacher's classroom, program activities, unique contribution of the host organization, follow-up, teacher leadership and responsibility, systemic connections, program administration,* and *program evaluation* (see Figure 1.2).

This process is the same whether looking at a proposed program or a program currently underway. This activity leads to a collaborative interchange among program directors, sponsors, and communities that strengthens the design of the program prior to operation. Program sponsors can apply the process to proposed programs as a way of making resource allocation decisions up front. The process is also particularly effective in looking at pilot programs before scaling up to full operations.

In either situation, the comparison yields a profile of the program's design compared with that of a quality program. The differences in the two profiles pinpoint deficits in the program's design that can be addressed immediately, before major expenditures have occurred. We find that these differences often arise from program directors, sponsors, and communities not thoroughly thinking through a program prior to full-scale operations.

This activity can be especially beneficial to program sponsors—individuals with oversight or accountability responsibilities for the program's success. Decisions whether to fund or continue support for a program can be made based on the profile of its design compared with the profile of a quality program.

Stage 2: Operating a Quality Program

In Stage 2, the process expands to look at the profile of the program *in actual operation,* compared with the profiles of (a) its design and (b) a quality program. It defines the extent to which a program's design is carried out in operation. This information alone is worthwhile. This activity goes further, however, to answer the question: To what extent does the program in operation reflect the profile of a quality program?

This activity involves fully describing the program in operation, which, in turn, entails assembling information on key aspects of the actual program. Program directors, staff, participants, and other related parties are the sources of this information. Several information-gathering mechanisms are available, including reviewing program documents; interviewing staff, participants, and others; and watching the program in operation.

This activity gives directors, sponsors, and communities insights into a program's status so that midcourse corrections can be made promptly. Midcourse corrections may focus on upgrading the program's actual operations to better reflect the profile of a quality program, on making the program's design and actual operations more congruent, or a combination of these. A program's cycle has optimal points where midcourse corrections may best be made. Sometimes they are between participant cohorts, where one group has completed the program and another is poised to begin. Sometimes they are between years of a program's operations. Sometimes they occur as frequently as between individual weeks of a program's activities.

Our experience shows that new programs rarely have operational profiles that mirror the profile of a quality program completely. Programs develop or stabilize over time. What directors, sponsors, and communities should be looking for is evidence that the program's design and operations become more congruent as they mature and that both more closely approximate the profile of a quality program. Directors of new programs should concentrate on developing program improvement plans based on the information gathered in this activity.

Stage 3: Investigating Outcomes

Outcomes are the end products—changes in teachers' knowledge, skills, attitudes, or habits of mind; changes in students' interest in, and excitement about, science and mathematics; or community policies and program parameters governing science and mathematics education. Each type of support program that we address here has a slightly different set of outcomes associated with it, which is one distinction among the program types.

Program directors, sponsors, and communities should begin seriously investigating program outcomes only after a program has operated for some time with opportunities for midcourse corrections. Program stability occurs when, after repeated cycles of Stages 1 and 2, profiles of the program's design and actual operations both reflect the profile of a quality program. We find that as a program more completely reflects the profile of a quality program, its outcomes strengthen, deepen, and spread.

This is not to say that directors, sponsors, and communities ignore outcomes earlier in a program's development. But, they should not hold a program *accountable* for outcomes until it has evolved into an effective program in operation. When directors, sponsors, and communities investigate outcomes too early in a program's development, they may or may not find much of substance. And when they do, they often cannot link or attribute the outcomes to the program's operation.

Investigating outcomes entails the accumulation of information about the effects of the program on its target audiences—teachers, students, schools, and communities. It involves obtaining information from outside the program itself, in classrooms, schools, and community settings. Information-gathering mechanisms often include surveys, interviews, and direct observation, as well as reviewing documentation.

The community must be careful to hold a program accountable only for *reasonable* outcomes. A community can expect too much from a support program of the types addressed here. Outcomes that are envisioned to occur far outside the operation of the program itself are more susceptible to influences by the environment. Just as research and expert experience indicate the components of quality programs, they tell us what outcomes are reasonable to expect as well.

If the program is designed and operating according to the components of quality programs, the outcomes should be there. If not, or if they are weaker than desired in the light of the cost of the program, then directors, sponsors, and communities should look first to the reasonableness of their expectations and second to the combination of components defining the program. Based on these examinations, decisions about refining program expectations or strengthening certain program components can be made.

WHO IS INVOLVED?

We have written this book for program directors, sponsors, and communities who are concerned with improving science and mathematics education for all students and who have chosen one or more of the support programs addressed here as an improvement strategy.

Program directors are those individuals with direct, day-to-day responsibilities for teacher development, teacher research, student enrichment, or systemic programs. They manage the program, recruit participants, hire staff, and allocate resources within the program.

Program directors usually report to someone else—either an individual or a group. These are *program sponsors.* Sponsors are accountable to the community at large for outcomes. Their responsibilities are monitoring and oversight. They usually do not participate directly in the program; rather, they rely on directors for insight and information.

The *community* is all the stakeholders affected by the program and concerned with its effectiveness and success. A community may be geographically defined as a school, district, or region. Or, it may be defined as a "community of interest," as with a group of colleges and universities all working to improve science and mathematics education in their respective localities.

In a school district in the community, program directors may be teachers, administrators, and district personnel. Program sponsors may be district superintendents, school boards, or other community groups. If the program is supported by state or federal education funds, program sponsors may be program officers, agency monitors, or members of governing boards.

Program directors and sponsors are essential to *profiling program quality.* We have written this book from their perspective. They are not the sole participants in the process, however. *Profiling program quality* is most useful when program staff, participants, and other related community partners are thoroughly involved. *Profiling program quality* aims to create and support a learning community that shares an understanding of the program and an investment in its success. The more inclusive the process, the better.

HOW IS PROFILING PROGRAM QUALITY DIFFERENT FROM TRADITIONAL PROGRAM MANAGEMENT AND OVERSIGHT?

At first glance, *profiling program quality* does not look much different from most program management and monitoring practices. But, it adds the critical dimension of what we know from research and repeated experience to be the critical components of quality programs. It gives directors, sponsors, and communities standards or benchmarks against which to compare the design and operation of their own programs. This is a big difference.

Profiling program quality and program evaluation have some similarities. Most program directors are familiar with formative evaluation and summative evaluation. Fewer understand design evaluation. The stages of *profiling program quality* roughly parallel these three types of program evaluation. *Design evaluation* corresponds to profiling the program design against the profile of a quality program. *Formative evaluation* corresponds to profiling the program in operation against that of its design. *Summative evaluation* corresponds to investigating outcomes. Directors and sponsors thoroughly versed and confident in design, formative, and summative evaluation techniques have an advantage in using *profiling program quality.* But, all too often, they skip immediately to summative evaluation with disappointing results.

The issue of comparing designs and operations to *what?* remains. Too often, we found programs that fared well from an evaluation perspective but still fell short of expectations, especially when compared with other programs with comparable costs. Why? Because even though evaluation efforts showed that the program achieved its goals and objectives, the goals and objectives were not a reflection of research and expert experience. They were not valued by the community, and they did not lead to improvements in mathematics and science education.

WHAT ARE THE BENEFITS OF PROFILING PROGRAM QUALITY?

The experiences of program directors and sponsors with whom we worked to develop the process point to several benefits of *profiling program quality:*

1. *Greatly increases the likelihood that programs supporting science and mathematics education will produce intended outcomes.* Programs designed and operated according to research and expert experience lead to stronger, deeper, and widespread outcomes. *Profiling program quality* gives directors, sponsors, and communities the comfort and confidence that their own programs will succeed.

2. *Identifies the most effective use of limited resources.* It gives directors, sponsors, and communities a common language, understanding, and conceptual framework within which to make decisions to fund, support, enhance, or expand a program. Simultaneously, it sets reasonable expectations: It

does not arbitrarily penalize new programs; rather, it provides guidance for program improvement.

3. *Quickly pinpoints program areas needing improvement.* It continuously compares all aspects of the program to research and expert experience so that directors and sponsors can act quickly to make midcourse corrections before time and money are expended on a less effective program. It provides guidance for directors to improve programs throughout their programs' life cycles.

4. *Reinforces directors and staff.* No one is more disappointed to find that a program is not realizing sound outcomes than dedicated directors and staff. *Profiling program quality* is a reinforcing process to individuals working hard to produce an effective program. It serves as a road map to success on which directors and staff can quickly locate themselves and make sound choices for continuous improvement.

5. *Builds a common language.* Too often, program directors, staff, sponsors, and community members talk past one another. Too late, the parties find that they really were not communicating about the program and its expectations. *Profiling program quality* is built around a common language adopted by program directors, staff, and sponsors to ensure that communications are explicit and consistent.

6. *Fosters consensus building.* It is a participatory process. In all activities, directors, staff, sponsors, and other related parties work together to gather, interpret, and share information about the program. Everyone invests in the same ideal and strategies for reaching this ideal. Understanding and applying the components of quality programs shape everyone's commitment to success.

7. *Boosts the community's confidence in education.* Communities have more confidence in education when they see and participate in confirming that their programs are effective. *Profiling program quality* involves the community. Parents and teachers become the program's strongest advocates.

Benefits of *profiling program quality* are only one side of the story. Costs are the other side. Directors, sponsors, and communities must weigh the costs of undertaking the process.

WHAT ARE THE COSTS?

Costs vary greatly from program to program and community to community. Whether communities feel the need to engage outside expertise to help them use the process is one cost factor. Every community, however, incurs some costs in financial and staff resources.

Financial Costs

It most often costs more to do a good job than a poor one. *Profiling program quality* costs more than just a summative evaluation effort at the end of a program. Additional dollar costs are likely in obtaining, organizing, analyzing, and interpreting the information to profile a program's design and operations against the profile of a quality program. Reporting is more frequent and extensive. If directors and sponsors think they must engage outside expertise to learn more about the process or assist with its use, costs will increase.

Personnel Costs

The time required by people in the process should be figured as a cost. Certainly, time will be spent in understanding and integrating *profiling program quality* into the community's program management routines. These should decrease over time, but at the beginning, these assignments will be additions to directors' and sponsors' current responsibilities. *Profiling program quality* is most useful when all parties vested in a program's success are involved. This includes program staff, participants, and other related parties from the community. Time must be allocated for meetings and gatherings and for using information about the program. This is beyond time spent truly understanding the components of quality programs, which most of us take for granted or only partially appreciate.

HOW DO WE USE THIS BOOK?

We have designed Chapters 2 through 5 in this book to help communities use *profiling program quality* step-by-step. We have included formats and procedures for communities to use. We believe that communities can adapt these if appropriate.

Chapter 2 describes the components of quality teacher development, teacher research, student enrichment, and systemic programs supporting the improvement of science and mathematics education. This is "must reading" for program directors, sponsors, and communities. It is the core of the process. We have included resources of easy-reference formats of each set of components, together with references to the formal and informal research literature from which the components were identified.

Chapters 3 and 4 should be used together. They are probably most useful to program directors. They lead directors and program staff through the first two stages of *profiling program quality.* Chapter 3 focuses on profiling a program design against the profile of a quality program. Chapter 4 looks at comparing three profiles: program operations, program design, and a quality program. Both chapters include actual examples from our work.

Chapter 5 looks at investigating outcomes: how the science or mathematics program actually leads to improvements in education for all students. This is Stage 3 of the process. Program directors, sponsors, and communities should all become familiar with this chapter, especially the importance of identifying reasonable, credible, and valuable outcomes that are linked logically to program operations.

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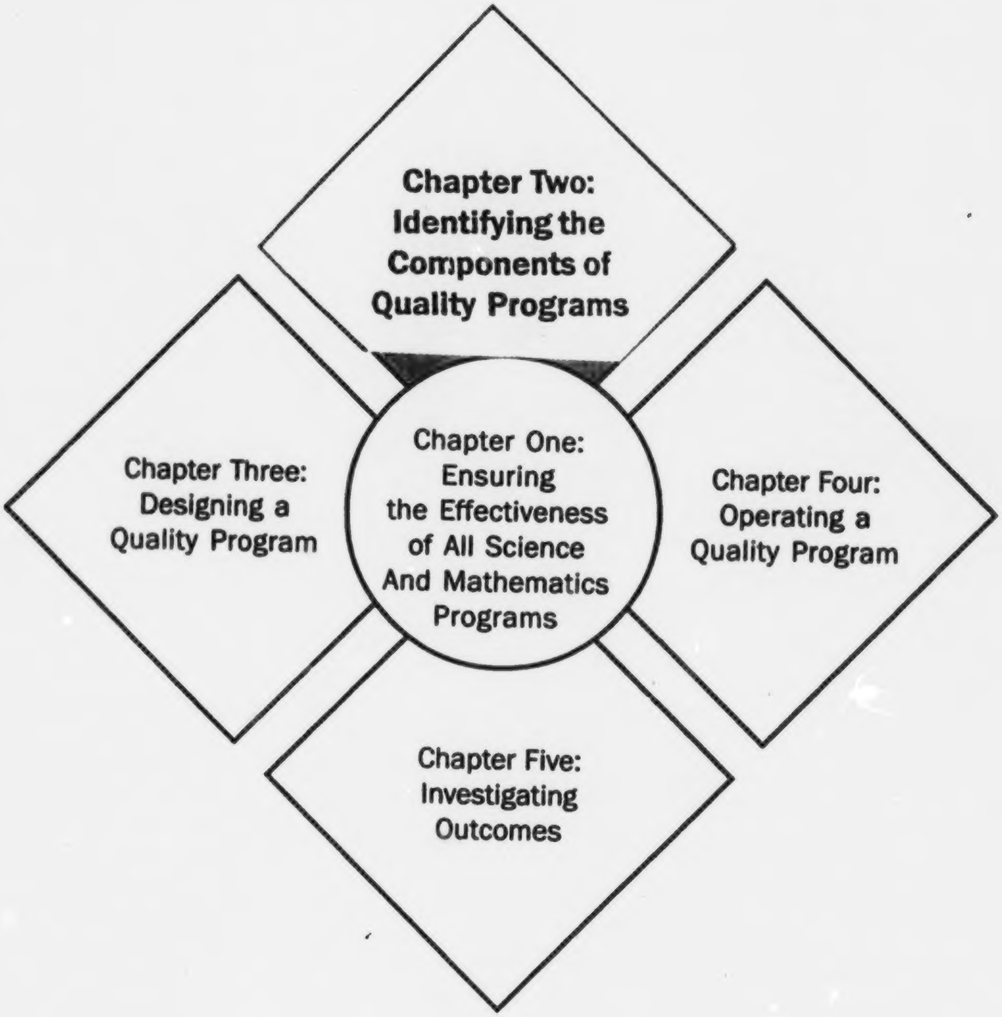
Chapter Two: Identifying the Components of Quality Programs
Chapter Three: Designing a Quality Program
Chapter One: Ensuring the Effectiveness of All Science And Mathematics Programs
Chapter Four: Operating a Quality Program
Chapter Five: Investigating Outcomes

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2

Identifying the Components of Quality Programs

HOW CAN THE SAME PROGRAMS BE SO DIFFERENT?

At the beginning, Anne Marie and her sister-in-law, Rachel, who lived downstate, were very excited. Their state had received money to conduct four month-long workshops on increasing the use of technology in elementary science instruction. Anne Marie was to attend the workshop in Region I of their state; Rachel, the workshop in Region II.

Because they both taught fifth grade and were interested in computers, they saw this as a great opportunity for them to share what they had learned. According to the workshop brochure, the event in each region was supposed to cover the same material, although each was conducted by local university personnel.

Rachel's enthusiasm was short-lived. By the end of the first week, she was ready to drop out. The logistics were not handled well. Teachers were meeting in a facility that was uncomfortable and not clean. Lunch each day consisted of sandwiches from a local supermarket. Although one instructor seemed to know his subject matter and communicated it well to the participants, the other instructor seemed disorganized and focused on topics that the teachers had little interest in and that had slight applicability to their classrooms. To make matters worse, four of them had to share a computer. Although the event was not a total waste of her time, Rachel was disappointed, especially when she talked with her sister-in-law.

Anne Marie was having a great experience. Her workshop met in the computer training room of a local business. The facilities were very nice, and the company's kitchen provided a good variety of sandwiches and salads for lunch, along with nutritious snacks. Both instructors were top-notch. They knew their material; they were well organized; and they actively involved the participants, taking their needs and concerns into account. Anne Marie was learning so much that she could take back to her classroom. In fact, every activity was designed so that the group could explore applications to the classroom and actually practice specific instructional strategies. So far, she thought each day was an excellent investment of her time.

The women wondered why two workshops, both under the same sponsorship, could be conducted so differently. How could this have happened?

All program directors and sponsors have probably had their own version of the Anne Marie and Rachel story. The perplexing question remains: Why are some training and professional development programs excellent, some mediocre, and a few downright awful?

The answer is relatively straightforward: Some programs reflect, embody, and use what we know from research and expert experience, and others do not. Until recently, groups providing training designed and conducted their events according to what they thought was appropriate. The same situation pertains to teacher research, student enrichment, and systemic programs intended to support excellence in science and mathematics education.

In Anne Marie and Rachel's case, even though the science and technology workshops had the same sponsorship, each was conducted by staff from a university within a region of the state. Although there were certain specifications (e.g., the workshop is 4 weeks long), much was left to the control of the local providers, whose levels of expertise in quality professional development varied greatly. Those in charge of Anne Marie's workshop were highly experienced and knew just what to do. Those conducting

Rachel's were experts in technology but knew little about training adults, especially teachers.

How could the discrepancy in quality be eliminated so that Rachel's experience was as positive as Anne Marie's? One way is for all workshop staff and directors to design and carry out the events in accordance with the characteristics of quality teacher development programs, which we know to apply on the basis of research and expert experience.

WHAT TYPES OF PROGRAMS ARE WE TALKING ABOUT?

This book looks at four types of programs intended to support improvements in science and mathematics education: (a) teacher development, (b) teacher research, (c) student enrichment, and (d) systemic programs. In particular, the book looks at programs that operate over some time—say, 3 to 5 years—and often work with cohorts of participants. Therefore, the programs have ample opportunity to gather performance information and refine both program design and operations between cohorts.

Teacher Development Programs

Teacher development programs are professional development programs for teachers. They are conducted over time, rather than being just a few hours in length. Such programs are conducted by colleges and universities, private organizations, states, and school districts. They are often funded by state or federal agencies. For example, the teacher development programs operated by the U.S. Department of Energy's (DOE) National Laboratories and those sponsored by the National Science Foundation (NSF) are often held for 2 to 4 weeks during the summer, with follow-up sessions during at least one subsequent school year. Teachers come to the program from the immediate area or sometimes from across the country. The programs give teachers the opportunity to develop positive attitudes, increased confidence, and new content, pedagogical, or assessment knowledge and skills—all of which teachers are expected to apply in their own classrooms.

Teacher Research Programs

Teacher research programs provide teachers with research experience in a scientific, technical, or other type of laboratory or research facility. Teacher research programs last between 6 and 8 weeks during the summer. Teachers become members of teams conducting research or exploring cutting-edge technology. Teachers attend as individuals; usually, one teacher is assigned to a research team under the eye of a research scientist, mathematician, or engineer in a mentoring role. The heart of the program is the teacher's firsthand experience with science, mathematics, engineering, and technology processes and knowledge of "real world" science and mathematics. The goals are to broaden the teacher's knowledge and experience base, revitalize the teacher's passion for science and mathematics, and transfer this excitement to teaching.

Student Enrichment Programs

Student enrichment programs, for K-12 students, are designed to enhance students' regular program of study. They are usually conducted by groups and organizations outside the school, such as business and industry, colleges and universities, community groups, or research facilities. These programs take place over a sufficient amount of time for students to acquire new knowledge, attitudes, and skills related to science and mathematics, usually by involving students in the process of mathematics or science. They often have a career development component. Their intent is to motivate students to study more mathematics and science, enjoy their study, and perhaps choose a career in the field.

Systemic Programs

Systemic programs usually involve several organizational partners who work together to bring about an educational reform in a community, region, or state. Systemic programs are a relatively new concept in education. They focus almost entirely on enhancing, improving, or in some way strengthening the environment that supports effective teaching and student learning. They look to leverage resources, individual programs and services, expertise, policy, and organizational structures to improve teaching and learning. Their outcomes include a shared vision of effective teaching and learning, as well as a shared understanding of the required environmental supports, improvements in individual support programs (like teacher development and research programs), increased coherence and coordination among components of the educational system and across systems, and changes in individual functions of the educational system—like curriculum, instruction, assessment, materials and resources, or governance.

HOW WERE THE COMPONENTS OF QUALITY PROGRAMS IDENTIFIED?

At the same time that various groups around the country have been developing standards, the National Center for Improving Science Education (NCISE [pronounced en-cize]) undertook a complementary effort with science and mathematics program directors and sponsors to summarize in a useful way what research and expert experience indicate is necessary for a successful teacher development, teacher research, student enrichment, or systemic program.

Staff from more than 50 state and local program settings formed development groups. Each group began with an intensive review of both the formal and informal research literature for each program type. Groups interviewed program staff and directors to gain their perspective on what factors contribute to a successful program. Groups met routinely to compare their findings, ask more questions, and identify more sources. After each group was satisfied that it had tapped a broad range of knowledge about each program type, it summarized its findings into a set of components associated with quality programs—ones that were effective and successful.

Deciding what constituted a component of a quality program was not automatic. Components often did not clearly emerge from the research literature. Sometimes the research and evaluation studies were contradictory, so expert experience—that of science and mathematics program staff and directors—became very important.

Next, the groups piloted their preliminary findings (components) to test not only their validity but also their relevance to science and mathematics program directors, sponsors, and communities. The education programs sponsored by the U.S. Department of Energy participated in this test, as did programs sponsored by the U.S. Departments of Education and Health & Human Services, the National Institutes for Health, the Smithsonian Institution, and the National Science Foundation. As a result, some components were omitted because they were not essential, and others were revised.

The development groups concluded that quality teacher development, teacher research, student enrichment, and systemic programs could each be described by between 8 and 11 components. Some components were common to several types of programs; others were unique to the type of program. The unique components actually *define* the program.

Both NCISE and its collaborators believe that the components for each type of program will continue to evolve. Research continues, especially in the light of the science and mathematics standards and reform, and more research will inform experience. Some program types—namely, systemic programs—do not now have a strong, longitudinal research base to inform experience. Finally, program directors, sponsors, and communities will find better ways to describe the components as they work with them.

WHAT COMPONENTS DO QUALITY PROGRAMS OF MOST TYPES HAVE IN COMMON?

Quality teacher development, teacher research, student enrichment, and systemic programs share several components. These relate to (a) program administration, (b) program evaluation, (c) follow-up, (d) unique contribution of the host organization, and (e) systemic connections. In each, the components may differ somewhat. They are always present, however.

Program Administration

A quality program has a clear set of program goals that are understood by participants, program staff, directors, sponsors, and communities. If representatives of all these groups were interviewed about the goals of the program, they would provide similar or equivalent responses. There is a consensus of what to expect from the program, and key program activities can be traced to one or more of these goals.

Without exception, a quality program always has someone in charge and the reporting lines are clear. Staff members have specific management roles and responsibilities. These include ensuring that resources are adequate and well managed; communicating regularly with, and reporting to, program directors and sponsors; maintaining records and a database of participants; establishing a relationship with the community (e.g., teachers' schools and districts) prior to, during, and after the program; and recruiting participants from, or working with, underrepresented populations in science and mathematics.

Administration ensures that different individuals from throughout the community (e.g., teachers, scientists, educators, parents, businesspeople) have input into the program's design and operations and are kept informed of progress. Administration's job is also to ensure that a collegial atmosphere prevails in the program. This means creating an environment in which professional exchange is encouraged, and mechanisms are created to make it happen. For example, opportunities are scheduled for teachers and scientists to discuss research or teaching topics; program staff are always accessible (e.g., have an open-door policy); participants are encouraged to pursue their own interests by linking with colleagues and scientists and mathematicians; conversation includes talk about the craft of teaching and scientific investigation; people listen to each other, value each other's contributions, and treat each other as peers; and participants themselves help administer the program.

In a quality systemic program in particular, program administration also includes leaders articulating the vision and managing the strategic plan; the partners paying attention to political issues; the partners modeling behaviors and strategies of collaboration, risk taking, continuous reflection, and quality; an effective fiscal system; and a specific plan for institutionalization of the major reforms at the end of the current funding period (if applicable).

Program Evaluation

A quality program takes evaluation seriously and builds it into the program design. Evaluation performs three functions. First, evaluation monitors that key program activities occur as planned or depart from the plan with good reason. Second, it assesses how well the program is operating *during* the program and provides information for program sponsors, directors, and staff to reflect on performance and to make appropriate changes. Third, it investigates and determines the outcomes of the program on a regular basis, not just at its conclusion. The program design and operations change over time (e.g., between participant cohorts or between years) on the basis of evaluation information. Until program personnel actually review evaluation information, explore its significance, and then make program changes, evaluation has really not occurred.

In all cases, the program evaluation looks to compare performance against benchmarks and expected outcomes as defined by the program's vision and goals. In this way, directors and sponsors know how to improve the program or gauge its effectiveness. Quality programs always have designs that make sense. They measure key activities and benchmarks that are truly critical to the program's long-term success. They rely both on quantitative and qualitative information gathered on a regular basis. They use appropriate analysis and interpretation techniques. They often call for separate evaluation staff to maintain an outside perspective and objectivity with respect to the program, although this is not necessary.

Follow-Up

Follow-up is a well-established component of quality programs. Perhaps a better term for *follow-up* is *follow-through*—as in following through on a baseball swing or throw. Quality programs are not designed as discrete events, but rather as continuous interventions toward a goal. Quality programs include follow-up activities, structured activities that take place as part of program design following the first major events for the purpose of continuing and enhancing the goals of the programs.

For example, in quality teacher development programs, follow-up may include continuing communication, workshops, classroom support, information sharing, mentoring, equipment loan, or extensions of the activity to a larger unit (e.g., from one teacher to an entire school faculty). Teachers may attend an institute one summer and then spend the next school year trying out their new knowledge and skills, returning periodically to the institute setting to share their experiences. During these mini-institutes, additional knowledge and skills may be introduced or reinforced.

For quality student enrichment programs, follow-up may be periodic communications with a student and her or his parents and teacher. With systemic programs, follow-up is part of building the capacity of the system to support changes and reforms in mathematics and science education.

Follow-up implies long-term commitment and support by the host organization in partnership with the school and community. Follow-up is an often neglected component of program designs, sabotaging the effectiveness of even the most well planned event.

Unique Contribution of the Host Organization

Quality science and mathematics programs of the types investigated here all operate within host organizations with specialized capabilities and resources, and these are an integral part of the programs. It is because of these specialized resources and the organizations' willingness to share them that they host the programs.

Participants in a quality program have extensive opportunities to interact with the wealth of technical and human resources available throughout the host organization (e.g., university, research laboratory). Often, participants work with advanced instrumentation and technical equipment not available to them in their schools or communities.

Organization staff—scientists, mathematicians, engineers—both work directly with participants and serve as consultants. For example, in a teacher research program, teachers may meet with one or more scientists serving as mentors for 2 hours each week. This is in addition to the teachers' research team work with these individuals. In these meetings, teachers discuss their research work and get feedback. Scientists learn the challenges that teachers face in taking their learning back to the classrooms and sharing it with students.

Systemic Connections

Quality programs do not operate in isolation. They operate as part of program portfolios intended to improve science and mathematics education, whether in schools, districts, or the broader community. Quality programs are always part of larger efforts connected through common vision and goals, similar activities, and ongoing networking and communication. In this way, they contribute to building the capacity of larger systems.

Perhaps the larger systemic effort is a statewide staff development program for teachers that covers all the major subject areas. Such a program is designed to change the nature of instruction for all grades in all schools across the state. It might be conducted by the state department of education, with a university providing a major portion of the staff development in science or mathematics for K-12 teachers through a portfolio of programs. In such cases, each program will align its goals, curriculum, strategies, and materials with those of the larger effort.

Unique Components of Quality Programs

Components common to many types of programs are not sufficient in themselves to define a particular program. Each type of program has several components unique to it that describe the essence of the program. These combine with those common to many program types to define the program fully. The next sections describe the unique components of quality teacher development, teacher research, student enrichment, and systemic programs.

WHAT ARE THE UNIQUE COMPONENTS OF QUALITY TEACHER DEVELOPMENT PROGRAMS?

Three components are associated with quality teacher development programs, in addition to the five found in quality programs of many types. These unique components are (a) vision for the teacher's classroom, (b) nature of program activities, and (c) teacher leadership and responsibility. The combination of these eight components (see Figure 2.1) defines a quality teacher development program.

Vision for the Teacher's Classroom

Quality teacher development programs are driven by a vision of the kinds of science and mathematics programs teachers should use with their students. A program's goals and objectives address this vision. Currently, thorough descriptions of classroom instruction in the standards are pub-

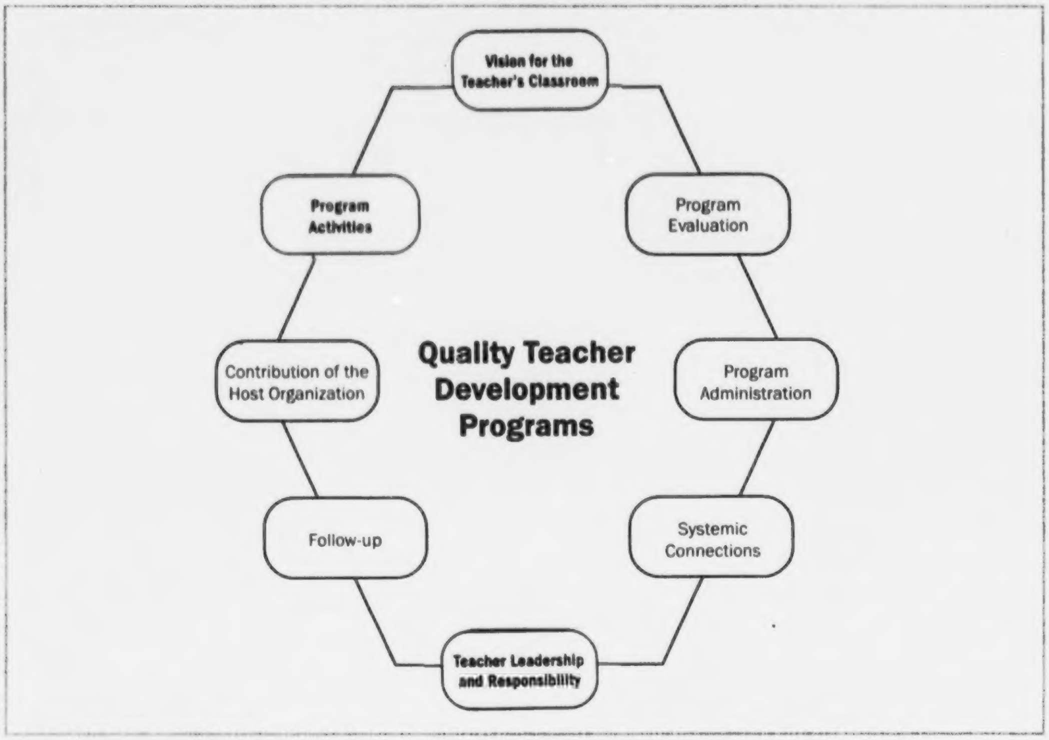
Vision for the Teacher's Classroom
Program Evaluation
Program Administration
Systemic Connections
Teacher Leadership and Responsibility
Follow-up
Contribution of the Host Organization
Program Activities
Quality Teacher Development Programs

Figure 2.1 Components of Quality Teacher Development Programs

lished by the National Council of Teachers of Mathematics, the National Research Council of the National Academy of Sciences, and the American Association for the Advancement of Science.

Classroom instruction focuses on students' deep understanding of major science and mathematics concepts or principles, and development of skills and habits of mind. It is important that the focus is not on the learning of disconnected facts or vocabulary words. Skills include generic thinking skills, mathematics- or science-related thinking or process skills (e.g., critical thinking, designing investigations, inferring, estimating, predicting), and laboratory skills (e.g., using equipment, measurement). Habits of mind include attitudes and dispositions important to scientific thinking and investigations, such as honesty, skepticism, tolerance of ambiguity, and a desire for evidence.

Quality teacher development programs help teachers develop an inquiry-based approach to teaching that includes not only hands-on experience or activities but also ways for students to develop new understandings from these activities. These programs envision elementary, middle school, and high school mathematics and science lessons that follow a model such as

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NCISE's model for teaching and learning (or one similar): (a) invitation; (b) exploration, discovery, and creation; (c) proposing explanations and solutions; and (d) taking action.

In other words, learning begins with an invitation, which originates with a question about the natural world. Next, students have ample opportunities to observe, collect data, organize their information, and think of experiments they might try. The teacher's role is that of facilitator, who guides, rather than dictates, students' learning. Third, students continue to refine their understanding of a concept. They analyze data and consider alternative interpretations. They may conduct additional investigations focused to obtain data to help them resolve conflicts between their previous understanding of a concept and the newly developing one. During this stage, students may be engaged in cooperative learning. Finally, once students have acquired a new view of a concept, they are ready to act on that knowledge. That could mean writing a letter to the local newspaper or defending a particular point of view. The teacher encourages the students to take appropriate action and helps them transfer their knowledge to other areas. In this work, students are engaged in hands-on/minds-on activities, neither simply listening to the teacher lecture nor observing a demonstration. The teacher will also use materials, strategies, and perspectives to accommodate the learning style of students in her or his classroom, along with testing strategies that actually capture what students have learned.

Quality teacher development programs help teachers develop lessons or teaching strategies that explore fewer concepts in greater depth than is common practice in schools, where the amount of vocabulary in mathematics and science texts exceeds that in foreign language texts. Programs help teachers select and delete or give superficial attention to some concepts and skills while exploring others in depth. Quality programs also emphasize and model both knowledge and skills as important outcomes of mathematics and science.

Finally, quality programs model authentic assessment, the kind of assessment of student learning that measures important learning outcomes, such as understanding principles and process skills, rather than those that are easy to measure—facts and vocabulary. Authentic assessment is also done in the course of instruction to monitor student understanding so that activities can be adjusted or new ones designed, rather than solely to give a final indication of whether or not learning has occurred. In this perspective, this component connects with program evaluation. Quality teacher development programs model the authentic assessment methods that they envision teachers using with their own students.

Nature of Program Activities

A quality teacher development program is reflexive; that is, it reflects in its own activities just what it envisions and advocates that teachers do with their students. Teachers, just like the students, are actively involved in "doing" mathematics and science during the program. They may be participating in the ongoing work of the host organization or involved in a simulation based on the work of their host. Whatever they are doing actually engages them in the process of mathematics and science. They are not listening to lectures or watching experts conduct demonstrations on a regular basis, although at times these activities may occur during a 3- or 4-week program. What the teachers experience meets their interests and needs and can be transferred easily to their classrooms. They work together in groups, practice new knowledge and skills, and have the support needed to make changes in their classrooms on their return.

Teacher Leadership and Responsibility

Expectations that teachers will demonstrate leadership and assume future responsibilities for sharing what they have learned is an explicit part of quality teacher development programs. Teacher leadership and responsibility includes teachers influencing their own learning experiences, applying their new knowledge and skills, sharing information with their colleagues, and networking with people outside the program. Often, the expectation is that teachers develop for professional organizations presentations based on their experiences or assume positions of responsibility within these organizations. Sometimes, teachers work with program directors and sponsors to facilitate change in mathematics and science education in their schools or districts; other times, they serve as mentors or coaches to other teachers or work across grade levels or schools to implement change based on their new knowledge and understandings.

WHAT ARE THE UNIQUE COMPONENTS OF QUALITY TEACHER RESEARCH PROGRAMS?

> Jolene Washington was very excited when she heard the news. The Lidell-Winstead Corporation, an aerodynamics research facility in her city, was starting a summer internship for high school science teachers. The company was recruiting 40 teachers to spend 8 weeks, from mid-June to mid-August, working in its laboratories.

This is what she had been looking for to broaden her teaching of physics, so she applied and was accepted.

According to the brochure, the goals of the program were (a) to provide teachers with experiences in science, mathematics, and technology in a research environment that had direct links to the military and commercial aircraft operations; (b) to offer teachers opportunities to interact with professionals from industry, the military, and academia in the fields of science, mathematics, and technology; (c) to broaden teachers' understanding of technical careers open to young people; (d) to allow teachers to have the experience of working alongside scientists, engineers, and technicians doing cutting-edge research; (e) to reenergize teachers and support their professional development; and (f) to help teachers develop materials they could use in their own classrooms.

At least, these were the goals on paper. Their implementation in the program was something else. Jolene had the sense that the program was planned by one group of people but conducted by another. Before enrolling, Jolene thought she would actually be part of a team conducting research on some aspect of aerodynamics. She was particularly interested in the effects of weather on small aircraft. (She had just started taking flying lessons.) That was not the case, however.

Jolene's day and that of her 19 colleagues (teachers were split into two groups) went something like this:

8:30 to 10:00	Listened to a lecture by a scientist or engineer on some aspect of the work going on at Lidell-Winstead. This always included time for questions.
10:00 to 10:15	Break
10:15 to 11:30	Divided into preassigned small groups to consider any applications of the lecture to their classrooms. All groups were self-managed, with staff there to answer questions and provide assistance if needed.
11:30 to 12:30	Lunch

This routine had some variation. One day a week was devoted to a field trip to a commercial airport, military air base, or other relevant facility. On these field trips, ample time was always provided for asking questions and talking informally with the scientists, engineers, pilots, and other staff. Once a week over lunch, different personnel from Lidell-Winstead talked to the teachers about the types of workers they were recruiting and what skills entry-level personnel needed to have to be successful.

At the end of the program, teachers in the two groups came together to present the materials they had developed for their own classroom use and to share those with the other group. The company had promised to duplicate all completed instructional units and to provide each teacher with a full set.

At the end of the program, Jolene had mixed feelings about what she had experienced. She had learned a great deal about aerodynamics research, including her special interest, the effect of weather on small aircraft. She had been inside several different facilities that she had wanted to see for some time. She also had ideas and resource materials for how to incorporate some of what she had learned into her physics classes. She had also broadened her network of professional colleagues whom she could now contact at any time. She also knew what jobs were available at the company and what students needed to know and do to get those jobs.

But several things were missing for Jolene. Visiting the different laboratories made her want to skip the lectures and small groups and actually go to work. She thought that an in-depth experience working in one laboratory would have been better than the lectures and tours of the company's major functions. Much of the content the teachers had learned was simply not applicable to the classroom—or if it was, in a drastically simplified manner. Although she found all the lectures interesting, several had little relevance to her curricula. Moreover, at the end, she was getting four boxes of materials, most of which had limited use. She thought the two groups coming together only at the end of the program was a case of bad timing. If they were going to share, they should have worked together all along.

Overall, she was very grateful for having had this experience. On the one hand, she had learned so much and was indeed revitalized for teaching (and for getting her pilot's license). On the other hand, she thought that the program publicity had been misleading and that the program had not delivered what the publicity promised. Maybe she was just being picky, but she thought she could have gotten a lot more.

Four components define quality teacher research programs in addition to the five components common to most programs. Jolene's experience

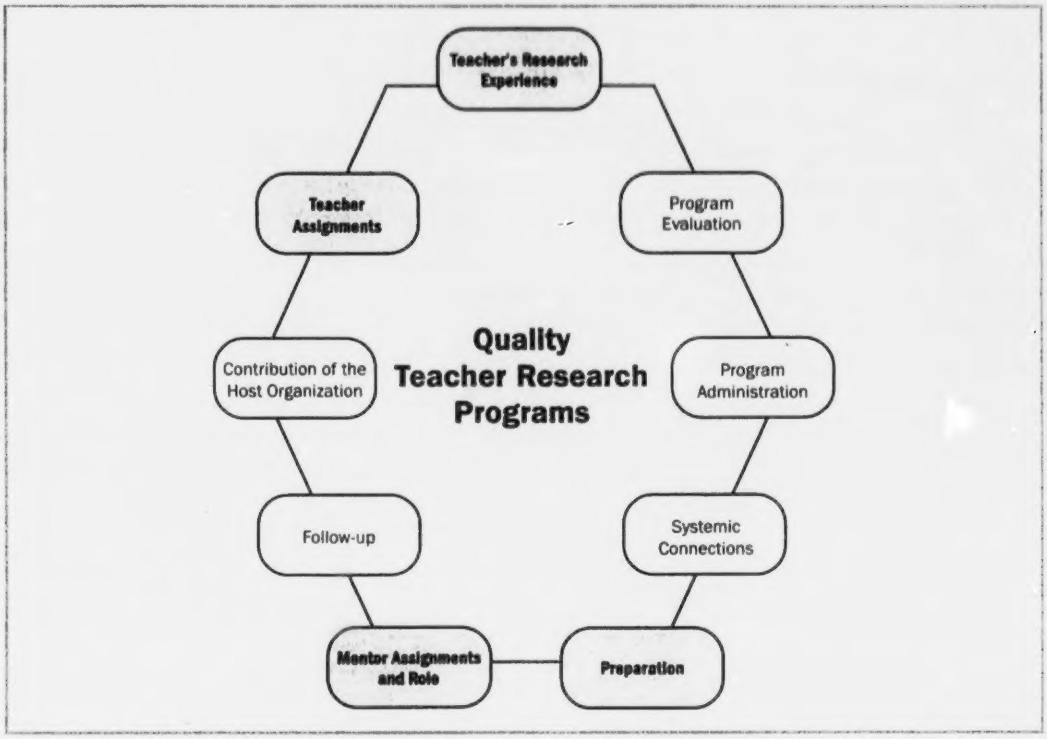
Teacher's Research Experience
Teacher Assignments
Program Evaluation
Quality Teacher Research Programs
Contribution of the Host Organization
Program Administration
Follow-up
Systemic Connections
Mentor Assignments and Role
Preparation

Figure 2.2 Components of Quality Teacher Research Programs

missed the mark in defining itself as a quality teacher research program. It lacked the four unique components of quality teacher research programs: (a) the teacher's research experience, (b) teacher assignments, (c) mentor assignments and role, and (d) preparation. The combination of these nine components defines a quality teacher research program (see Figure 2.2).

The Teacher's Research Experience

In a quality teacher research program, the teacher's research experience is the essence of the program. The teacher is part of a research team, working closely with others in carrying out the work of the host organization (e.g., university, research laboratory). The teacher spends most of her or his time so engaged.

Even though the teacher is part of a team, she or he has a specific research task to pursue that requires working the way mathematicians, engineers, and scientists do. This task is related to the work of the teacher's mentor. It is something the teacher has sufficient knowledge and skills to do without constant assistance or supervision.

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At the same time, the task exemplifies the research experience—with uncertainties, false starts, and loose ends. In completing the task, the teacher is exposed to new technology and gains a broader understanding of the area of research, including the mathematics and scientific literature. Although it is unlikely that the teacher will complete the task in the time available, she or he can spend enough time to learn how mathematicians and scientists work and to acquire some skills in carrying out the scientific process. Ample opportunity is given the teacher to share her or his outcomes with the organization staff and other teachers.

Teacher Assignments

The teacher's research assignment is challenging but not frustrating and overwhelming. The assignment immerses the teacher in all elements of the research process so that she or he can gain a full understanding of the nature of research. Assignments last for several weeks. An assignment appropriately links the teacher's own mathematics or science knowledge, skills, and interests with the work done by the host organization. Finally, the assignment addresses ways to transfer the research experience to the teacher's classroom.

Mentor Assignments and Role

In a quality teacher research program, teachers work directly with mentors—senior scientists, mathematicians, or engineers. Mentors spend time with teachers; they work together on research tasks, and they meet regularly to discuss not only the teachers' own research but implications for classroom instruction as well. Specific program activities are usually designed (as part of the *program administration*) to brief potential mentors on the goals and operations of the program. These include discussions with veteran mentors and program staff about what it is like and how to work well with teachers. Program staff communicate intensively with both the teachers and the mentors during the first weeks of the experience so that questions are answered and issues are addressed before problems arise. Mentors also meet regularly to reflect on and share their experiences and to plan future activities.

Preparation

Teachers coming to an intensive research program usually lasting 8 or more weeks during the summer are prepared so that they can have a successful experience. Preparation is both logistical and substantive. Teacher research programs are often national in scope, so travel and housing arrangements are important. During preparation, program staff ensure that teachers and mentors have similar expectations. Teachers are required to do pre-work and readings prior to their arrival.

WHAT ARE THE UNIQUE COMPONENTS OF QUALITY STUDENT ENRICHMENT PROGRAMS?

Randall and Virginia Winter were amazed at their son Mark's enthusiasm the first day he came home from his program at a national scientific research facility in their community.

Mark's sixth-grade class was spending a week studying science at the facility's education and training center. Mark and his family had been informed 2 months earlier that all fifth and sixth graders in Mark's school would participate in a program to broaden their understanding of environmental science and experience with the scientific process. The program was a cooperative venture between the facility and the school district in which it was located. After reading about the goals and activities of the program, Mark was very excited because science was his favorite subject. His parents thought the experience would be good for him, so they readily signed the permission slip and returned it to the school.

About 3 weeks before Mark's class was to start, the Winters received details about what the students would be doing each day. They also received a name and telephone number for them to call if they had any questions. In addition, all parents were invited to an open house on Thursday night of Mark's program to tour the facility and to learn more about what the students had done during the week.

To help students understand both the nature of the facility's work (environmental cleanup) and environmental science, staff had constructed a small dump on a section of their land. It was situated near two ditches so that some runoff would be created. The students' challenge during the week was to determine the extent of pollution that existed, the effects of such pollution, and what measures would be necessary to eliminate it.

The 25 students in Mark's class were divided into teams of five, each with a staff member to guide their work. Mark's teacher, who had been trained by the laboratory staff, was also a team guide. On the first Monday, each team was given its task and began to organize. The team guide was there to assist the students—helping

> them ask the right questions and assisting them in securing what resources they needed. Two scientists acting as resources were with the group at all times.
>
> By the end of the first day, Mark's group had taken soil and water samples from various locations in and along the ditches and taken them back to the lab for testing. In addition, each team had a journal in which a recorder had taken lots of notes. The next morning, the students were going on a field trip to their own city dump to learn how it controlled pollution and to apply their knowledge to their own dump site. Next, they would check the results of the soil and water tests and head back to their own dump site.
>
> Mark told his parents everything that had happened during the day, as well as what the students were going to do on Tuesday. He had not been this excited since his soccer team won the regional championship. His parents were impressed. This must be an exceptional program.

Quality student enrichment programs have four components unique to the type of program, and Mark's environmental science experience appears to reflect most of these. The four components are (a) program activities, (b) student selection, (c) preparation, and (d) program design. Together with the five components common to many types of quality programs, the nine components define a quality student enrichment program (see Figure 2.3).

Program Activities

The program activities component is key to why an organization conducts an educational enrichment program for K-12 students. A quality student enrichment program draws on the resources of the host organization to immerse students in investigations related to the ongoing work of the organization and to provide students with experiences not available in schools (e.g., equipment, materials, technologies, methodologies). One major challenge is providing age- and developmentally appropriate experiences for students, as well as having activities that take into account individual differences in gender, cultural background, and learning style. Moreover, students' experiences relate to their school curriculum and are exciting, enjoyable, engaging, and challenging. Students often work in teams and always with mentors guiding and supporting them. The activities provide opportunities for students to develop career life-planning skills and give special attention to building individual self-confidence and interpersonal skills. A quality program almost always requires students, regard-

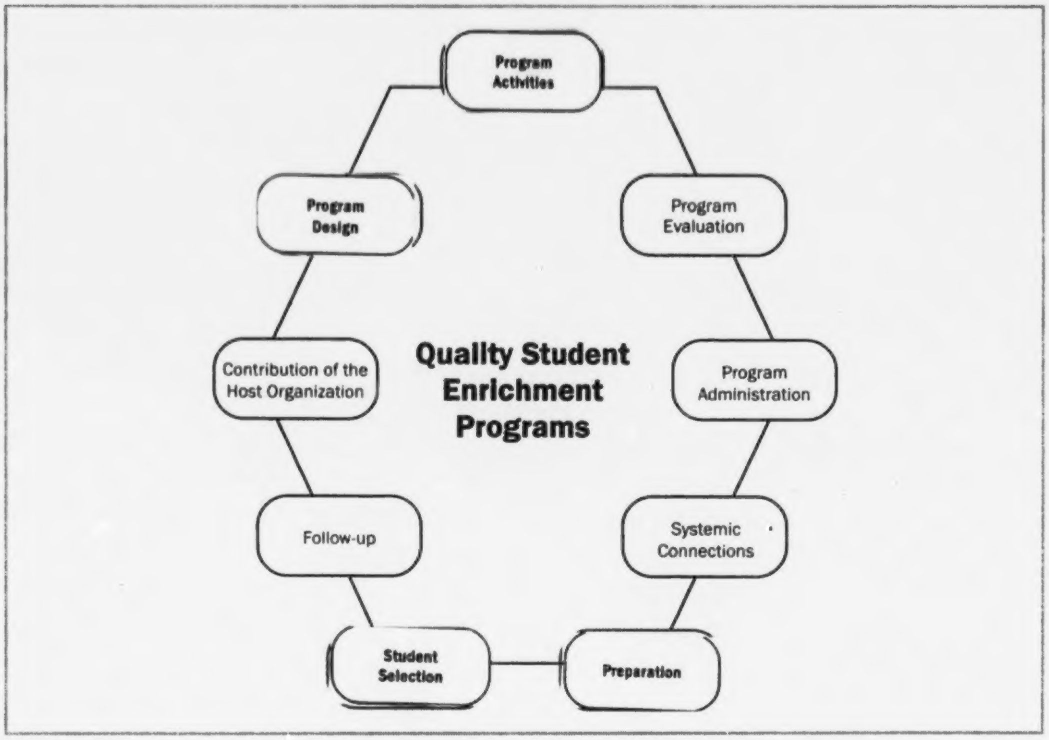

Figure 2.3 Components of Quality Student Enrichment Programs

less of age, to develop and exhibit work that represents what the students have learned as a result of the enrichment experience.

Student Selection

A quality student enrichment program makes every effort to recruit students who are least likely to participate in such a program—often at-risk students or those from underrepresented populations in mathematics and science professions. They follow a prescribed procedure with explicit criteria for selection. The criteria involve the students' regular mathematics or science teachers in the process. Selection and recruiting actively involve both the students' parents and schools to ensure their continuing support and commitment to the students after the programs.

Preparation

A quality program takes great care in preparing students, parents, and school personnel for the enrichment experience. Preparation often includes having an orientation night for students, parents, and their teachers at which

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they are given an overview of the program. Parents want to know where their child will be, who the mentors and instructors are, what the child will likely get out of the programs, where the child will be living (if the program is residential), what safety measures exist, and what costs (if any) are involved. Teachers want to explore how they can best support their students before and after the program and extend the enrichment experience.

Another common preparation activity is having an open house at the organization where parents and teachers learn about the work of the organization and see firsthand what the students are doing. A quality program solicits parents' and teachers' assessments of the students' experiences.

Quality student enrichment programs include special preparation activities for potential student mentors. As with teacher research programs, this often entails pairing first-time mentors with veterans or having routine discussions among mentors for the programs.

Program Design

The goals of a program are clearly defined and understood by students, parents, and teachers. The program reflects the findings of research and expert experience regarding programs for students in mathematics and science. A broad base of individuals is involved in the program design; the learning environment is safe and supportive. The program design includes explicit linkages with other programs, the students' schools and districts, and other research organizations.

WHAT ARE THE UNIQUE COMPONENTS OF QUALITY SYSTEMIC PROGRAMS?

The Mission: to increase mathematics and science literacy for all 200,000 students in a largely rural state over a 10-year period.

The Plan: to undertake a systemic approach involving key individuals and their organizations at the state and regional levels. These include, for example, the state department of education, the governor's office, the major university in the state as well as other postsecondary institutions in the four regions, the state's business and industry roundtable, museums, major educational groups in the state such as the PTA and teachers' and administrators' associations, and, of course, school districts.

> Supported by federal funds matched, in part, by the state's leading industry, the core group was set up as an independent, nonprofit entity charged with bringing all these groups together to develop a partnership to carry out the mission.
>
> Jacque Lee was appointed by an oversight board (made up of representatives from the groups listed above) to head the effort. He hired staff, developed policies and procedures for this new entity (called CORE), and set out to build a statewide structure for carrying out the project's work. One of his first efforts was to establish a "working" group made up of representatives from the key organizations that constituted the oversight board. This second, slightly smaller group was made up of individuals who would actually do the project's work, as contrasted with the oversight group, which drew together heads of these different organizations.
>
> This working group began sorting out roles and responsibilities. CORE, in conjunction with university and school personnel, would design a major change initiative for districts across the state. It would be piloted in one district in each of the four regions and then turned over to regional personnel to guide the implementation in other districts in their areas. CORE would be available for technical assistance and would provide evaluation services.
>
> At the same time, the other partners in this systemic effort would address related issues. For example, each postsecondary institution had agreed to bring its teacher training program in line with the state's mathematics and science frameworks. Business, industry, and museums had agreed to set up internships for students, as well as for teachers.
>
> The governor's office had taken the lead in working with the legislature to change state regulations limiting the number of in-service training days that school districts were permitted. The state department of education's textbook adoption committee had agreed to align its recommendations with the state's curriculum frameworks, a task that had not been done previously because of dissention within the committee.

Indeed, this was a systemic program plan. Jacque clearly realized the broad and complex agenda before him. The tasks themselves were challenging, and the politics were even more daunting. We wager that Jacque was surprised at his progress early in the project, probably thinking he was on the right track, but some days not sure.

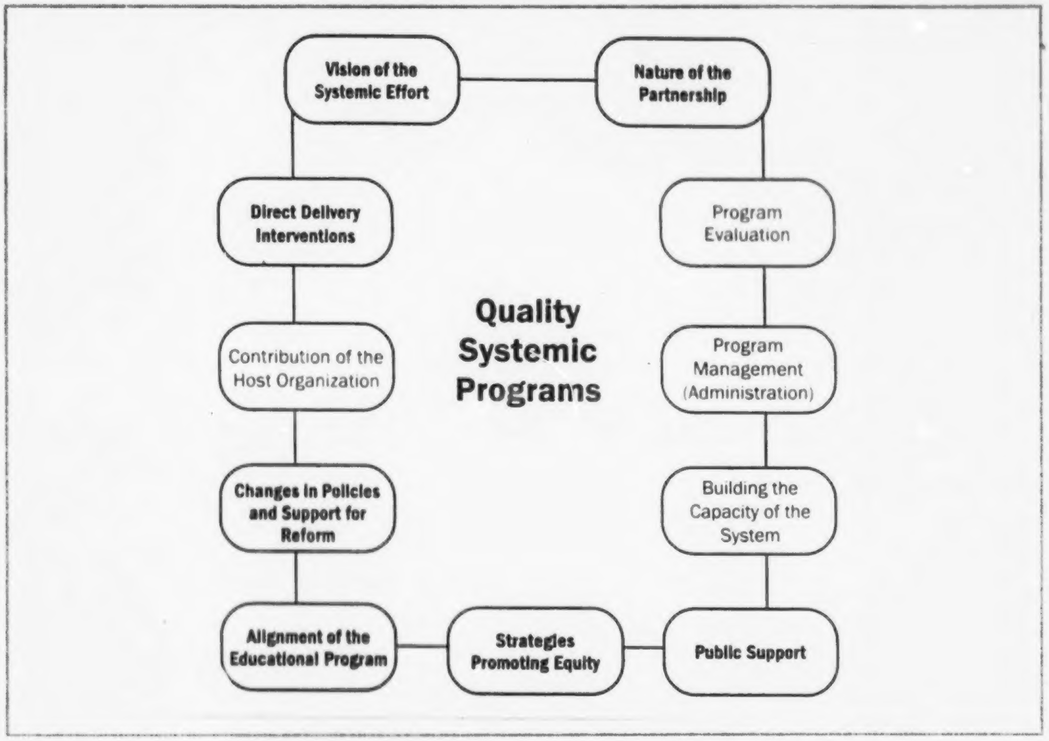
Vision of the Systemic Effort
Nature of the Partnership
Direct Delivery Interventions
Program Evaluation
Quality Systemic Programs
Contribution of the Host Organization
Program Management (Administration)
Changes in Policies and Support for Reform
Building the Capacity of the System
Alignment of the Educational Program
Strategies Promoting Equity
Public Support

Figure 2.4 Components of Quality Systemic Programs

Systemic programs are the most complex type of program addressed in this book. They are also the newest type of program with the smallest research base. On the basis of our current knowledge base and understanding, quality systemic programs have seven unique components that define the effort, some of which are illustrated in the previous example. These seven unique components are in addition to the four components that quality programs of many types have in common (see Figure 2.4): (a) vision of the systemic effort, (b) nature of the partnership, (c) direct delivery interventions, (d) changes in policies and support for reform, (e) alignment of the educational program, (f) strategies promoting equity, and (g) public support.

Vision of the Systemic Effort

Each type of quality program has a component that drives its definition. In the case of systemic programs, it is the vision of the systemic effort. In these programs, *all* the partners in the reform have a shared vision. This vision targets students and teachers, as opposed to changes or conditions in

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organizations or policies and programs; these are means to the end. Student and teacher outcomes are state-of-the-art, consistent with state and national standards.

Nature of the Partnership

Quality systemic programs view the partnership among participating organizations as central to the design and intention of the reform effort. The partnership is inclusive: It involves all the major stakeholders representing key groups within the community that are concerned with schools and youths. A governance and management structure with clearly defined roles and responsibilities is evident, often in response to a strategic plan. The plan includes ways of leveraging resources among the partners; this is a *real* leveraging of resources, not just in-kind contributions that are already available. There is regular communication and a prevalent feeling of trust and positive working relationships. Individual partners understand that some risk is involved in the effort and that its success is likely to necessitate changes in individual partner organizations.

Direct Delivery Interventions

Quality systemic programs revolve around multiple delivery interventions, as opposed to focusing on a single change. These often include professional development, consultation, coaching, new curriculum materials, provision of resources, changes in school structures and governance, or some combination of these and others. An audit of resource allocations reveals that the majority of the effort's resources are allocated to direct delivery.

Changes in Policies and Support for Reform

Organizational policies usually need to change to support the vision of the systemic effort. If schools are a target, these are policies such as how schools make decisions, structure of the school day and/or year, allocation of resources to various schools, new teacher orientation, ongoing professional development, and assessment practices. Policies targeted for change can originate at the school, district, or state level. Teacher preparation, licensure, and induction are examples of statewide policies targeted for change.

Alignment of the Educational Program

Quality systemic programs seek to change curricula and materials, instructional strategies, and assessment to align with each other, state and national standards, and the vision of the systemic effort. One direct delivery intervention in quality programs is a thorough examination of the educational program and its support systems to uncover components that are not responsive to state and national standards or that are inconsistent.

Strategies Promoting Equity

Quality systemic programs use interventions and strategies that have demonstrated success with minorities and females. They employ instructional strategies and materials that are culturally sensitive; they value diversity, rather than see it as a detractor from the educational program. Quality programs also pay particular attention to recruiting participants for specific activities that represent populations traditionally underserved in mathematics and science.

Public Support

Quality systemic programs undertake specific communication and engagement strategies to involve nonparticipating stakeholders (e.g., legislators, special interest groups, the public). These strategies are ongoing throughout the effort, not just concentrated near the end or at the beginning.

Building the Capacity of the System

Quality systemic programs understand and act on the tenets of large-scale change. Sustained attention is given to institutionalizing the reform effort from the beginning. For example, quality programs pay attention to creating and institutionalizing an infrastructure for change and renewal as part of their strategic plans. They focus on broadscale leadership development and skills, collaboration, change management, and systems concepts. Networking among the partners and other reform efforts is active. Attention is given to dissemination (as part of public support) throughout the effort, not simply near the end.

HOW CAN WE IDENTIFY COMPONENTS OF QUALITY PROGRAMS OF OTHER TYPES?

Our experience suggests that the five components of quality programs common to several of the types we investigated are, in fact, components of quality programs of all types. These are (a) program administration, (b) follow-up, (c) unique contribution of the host organization, (d) program evaluation, and (e) systemic connections. They may appear in a somewhat different form, but they will be present. So, program directors, sponsors, and communities wishing to identify components of quality programs have a head start.

What remains to be identified are the components unique to the type of program—say, for example, a pre-service internship for prospective teachers or a teacher mentoring program. A very strong motivation must drive this process because identifying the components associated with effectiveness is intensive and time-consuming. The fact that "it seems like a good idea" is insufficient and will not sustain the effort.

Assuming that sufficient motivation, time, and resources exist, the first step is convening a development group. The best groups are composed of individuals having different perspectives about the program under consideration, research knowledge, and good "investigating" skills (e.g., searching for and ferreting out information). The development group begins by reviewing the formal and informal literature. The group also interviews program directors and sponsors who have extensive experience with the type of program. Once group members are reasonably assured of having tapped a broad range of knowledge about the program, they summarize the information into a set of components. What's tough is describing each component succinctly.

The group will undoubtedly find that deciding what constitutes a quality program is not automatic. Components often do not clearly emerge from the literature. Sometimes, the research and evaluation studies are contradictory, so expert experiences become very important. At other times, the literature and experience may be contradictory, so a choice has to be made. Finally, the component may be clear but not appropriate politically. For example, with a pre-service internship, the literature and expert experience could show that a 2-year internship is required to lead to the knowledge, skills, and understandings desired in beginning teachers. And, this is a full-time internship with prospective teachers working in schools with master or mentor teachers. Putting such a program in place may be infeasible, given resources and community support.

Once the group has identified the plausible set of components, the set needs to be tested in a pilot study. One such approach would be to examine programs recognized as exemplary according to the components that have emerged thus far. Exemplary programs should exhibit the components. If not, the components need to be revised. The pilot study should also test the clarity, relevance, and usefulness of the statements themselves. Those unclear or irrelevant should be refined or omitted. Components that survive the pilot study can be distributed and used by communities conducting that particular type of program.

WHAT IS LIMITING THE IDENTIFICATION OF COMPONENTS FOR ALL TYPES OF PROGRAMS?

If this is such a valuable thing to do, the logical question that follows, then, is, Why hasn't it been done? There are four major reasons:

1. *The movement in education to look at results (outputs) along with resources (inputs) and activities (process) is relatively new.* Only recently has education realized that focusing on the actions without looking at the results is insufficient and potentially wasteful. The best purposes, planning, and programming may not yield the anticipated outcomes. This refocusing has, in part, led to the development of standards in some content areas.

2. *Many fear that focusing on what works will dampen energy and enthusiasm for creative approaches.* We don't believe this is true. Innovation is a research activity whose intent is to strengthen and broaden the knowledge base about program effectiveness. Innovation is the work of small pilot studies that combine components of effectiveness in different ways and under different conditions. We are talking here about broad-scale programming—entire schools, districts, or states, for example. These communities are not the subjects for research; too much is at risk. To continue to improve education for all students throughout the country, we need both—innovation and the implementation of quality programs. We just do not believe that program directors, sponsors, and communities should confuse these two endeavors.

3. *Until recently, education has not been subject to the accountability demands of other segments of society.* For a long time, education has largely escaped the movement for accountability of results. Teachers, schools, and districts, along with colleges and universities, governmental organizations, and other providers of educational services have been exempt from demonstrating that their programs actually had the impact they claimed. More and more, however, parents and communities are demanding that schools educate their children to higher and higher levels. Various groups, including Congress, are demanding more proof that their dollars are well spent. Attention to *program evaluation* used to be minimal. Now, evaluation is more likely to be addressed, and the federal government is investing large sums of money in evaluation to determine the impact of dollars spent. Relying on the components of quality programs in designing and operating programs is one way of ensuring accountability.

4. *Identifying these components is a labor-intensive effort.* The national media have chronicled the incredibly long and laborious process that groups have gone through to produce standards in mathematics, science, social studies, English, history, and other content areas. Identifying the determinants of program effectiveness is also an intense process, requiring time and resources. Funding sources for this type of endeavor have been limited.

HOW DO WE USE THE COMPONENTS OF QUALITY PROGRAMS?

A quality program is no longer somebody's best guess or personal preference. Program directors and sponsors should rely heavily on the components of quality programs when designing, operating, or investigating the outcomes of their own programs. Building in and monitoring the influence of each component drive the community's efforts to design, operate, and evaluate a program.

Common Expectations

It is crucial that all stakeholders in a program's long-term success share an understanding of the program and its components. Using the components of quality programs leads to all parties—program directors, staff, sponsors, and community—holding common, reasonable expectations for the program.

Program sponsors play a key role in setting program expectations that reflect the components of quality programs. Too often, sponsors appropriate funds for a program without fully specifying what they expect the program to accomplish. Calls for goals are often vague or unrealistic, as are descriptions of desirable program outcomes. Sponsors frequently specify program components, such as appropriate activities or evaluation, without describing what "appropriate" really is. We believe that "appropriate" equates to following the relevant components of a quality program, and sponsors should state this.

Sponsors are often in a situation of choosing among program alternatives. They receive more good ideas than they have money to support. How to choose? We propose that sponsors select the program designs that most reflect the components because these are the programs with the greatest promise of success.

Programs are more successful when the community supports them. Otherwise, when community support wanes, the programs are extinguished.

In education, we often ask the community to have faith or trust us. This won't work. The components of quality programs give the community a sound reason to support a program, particularly through its infancy, when numerous design and operational revisions will probably be required. The more the community understands about the components and the program directors' and sponsors' efforts to reflect these, the more support will be sustained.

Accountability

Program directors should demonstrate to sponsors and the community that programs reflect the components of quality programs. Where the program designs do not reflect one or more components, program directors can plan improvement. Maybe it is a case of insufficient resources. Then, the inability to reflect a component—say, for example, follow-up—becomes a reason to increase resources for the program. Not to address follow-up adequately foretells a shortfall in results.

Or, maybe it is a case of insufficient will. Designing a program that conforms completely to the components is a big challenge. Maybe the design has not been thought through. Maybe operations do not match either the intentions or the components. In this instance, the parties had best "go back to the drawing board" and strengthen the program's design or operations if they expect sound results.

A frequent source of derailment for even quality programs is influences within the program environment that jeopardize success (discussed in Chapter 5). Systemic programs have increased in popularity to address these larger environmental influences. For example, sometimes teachers change assignments so often that they do not have ample opportunity to try to refine their practice on the basis of what they learned from a teacher development program. Or, the necessary curriculum and instructional materials are not available. Program directors have a responsibility to monitor these influences as well and to report their status to sponsors and the community. Only by uncovering them can they be addressed.

At the same time, it is rare that a new program reflects all the necessary components. We found when investigating quality programs that these evolve over time—say, 2 to 4 years, but longer for systemic or other complex programs. Numerous refinements and revisions were made before the program operated at full scale. In the early years, the components of effectiveness guided these program improvements. They become the standards for performance that directors, sponsors, and the community all use to monitor progress.

Resources A through D of this book contain profiles of quality programs for each type of program we examined. Each profile is simply the components found to be associated with quality teacher development, teacher research, student enrichment, and systemic programs. In the profiles, components are broken down into a set of descriptors for easy reference. Citations for each component correspond to references in Resource E that list the key formal and informal research sources from which the components were identified.

In our work, these profiles became "mental checklists" for program directors, sponsors, and communities. These people relied on these profiles as criteria for making decisions and monitoring program performance. We do not suggest that program directors, sponsors, and communities completely rely on us. The references are an initial reading list for directors, sponsors, and communities to use. Research and expert experience continue to grow, so reference lists are outdated quickly, but they are a beginning.

WHAT QUESTIONS ARE FREQUENTLY ASKED ABOUT THE COMPONENTS OF QUALITY PROGRAMS?

We worked with more than 50 programs supporting science and mathematics education to identify the components of quality teacher development, teacher research, student enrichment, and systemic programs. Program directors, sponsors, and community members often asked questions about the effort. The following questions are those asked most frequently.

1. *What difference will it make if I use the components of quality programs in my work?* Identifying key components for program success is, in essence, setting program standards. The standards come from research, as well as from the experience of skilled practitioners. We know what a good program is. A quality program is no longer somebody's best guess or personal preference. When you design programs to include the components of quality, you *will* achieve better outcomes.

2. *What is the source of the components?* The components come from a review and synthesis of the formal and informal literature on different types of programs plus the knowledge of experienced practitioners. The formal literature is that which is published. The informal literature includes unpublished research and evaluation reports. Interviews are often conducted with expert practitioners to document their knowledge and experience.

3. *Who decides what constitutes a component of a quality program?* Under ideal conditions, the components are clear from the literature and practitioners' experiences. Because that is not always the case, development groups generally agree on a decision-making process to use when research and expert experience are unclear, contradictory, or politically inexpedient.

4. *Is it possible to adapt the components discussed here to other types of programs?* It is possible to adapt the components we have identified to similar programs, but adaptation is more than slight tinkering. In most cases, it entails reviewing the knowledge base of a particular program type. That is the only way you will know whether to keep, delete, or add certain components. Otherwise, your definitions may be based on individual opinions, preferences, or hunches.

5. *What is involved in identifying the components of quality programs for other types of programs?* A great deal. First, a strong motivation is needed, with sufficient time and resources. The task itself entails a thorough literature review (both published and nonpublished), along with information gathering from experienced practitioners. A synthesis and review of the information lead to identification of components and descriptors. Next, a methodology and instrumentation for using the components need to be tested and refined.

6. *Are the components always readily apparent?* Sometimes, yes. Sometimes, no. In some cases, the components will almost leap off the paper. In other cases, they are more obscure; or research and evaluation studies may be contradictory. A difference may also be found between what the research identifies as a component and what expert practitioners say. Political realities may also affect the identification process. Developers may be hesitant to identify some component if none of the programs currently incorporate that component and may feel more vulnerable by doing so.

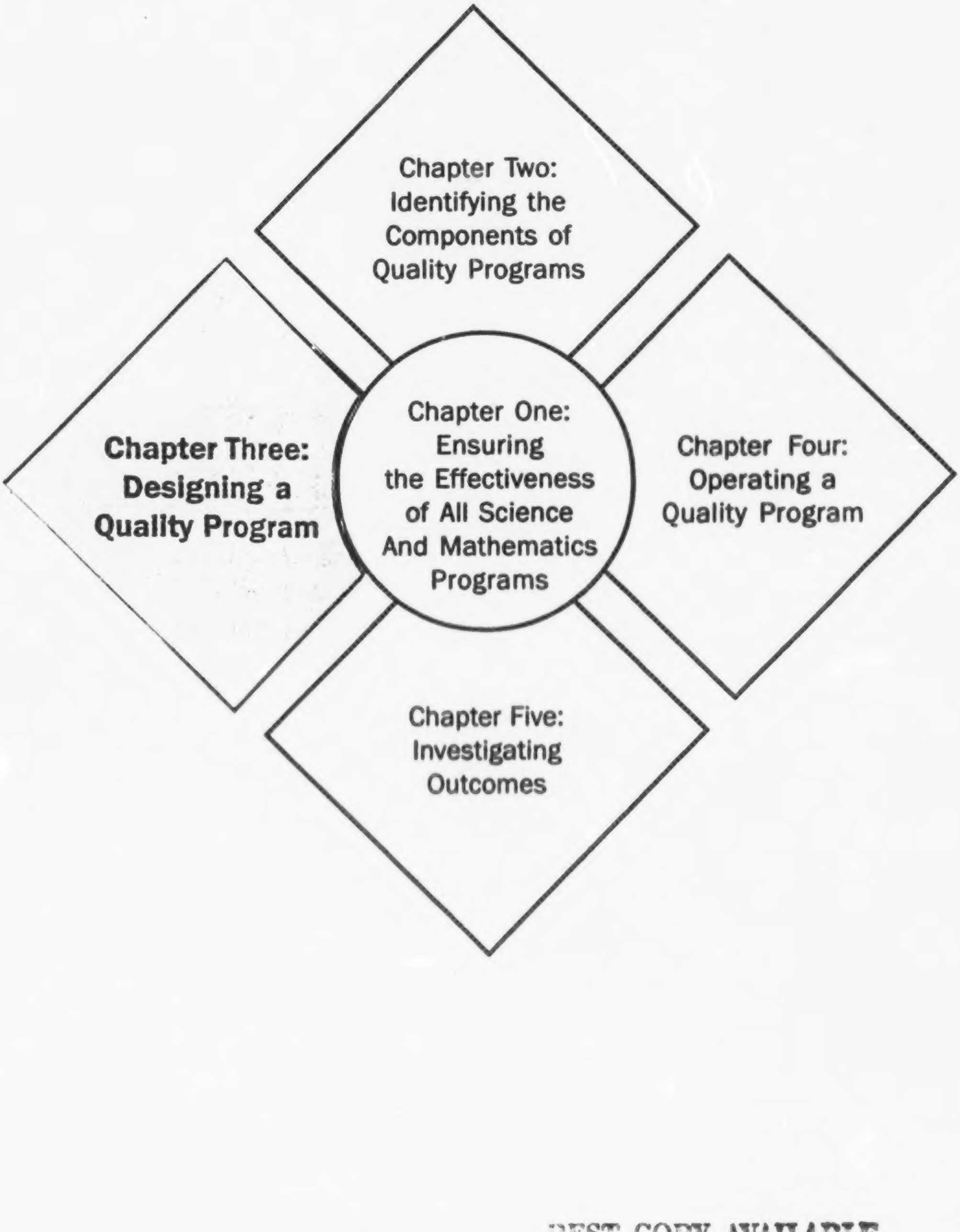
7. *Do certain components appear to be common to all programs?* From our experience, we would say, "yes." Likely candidates are *program administration, program evaluation, follow-up, unique contribution of the host organization,* and *systemic connections.* Each program, however, will have components that are unique, that define the type of program.

8. *I am confused by terms. What is the difference between a program component and a descriptor?* Descriptors fully explain a component so that program directors, sponsors, and communities can use the components to

design and operate their own programs. Consult the profiles of quality programs in Resources A through D of this book to see this structure.

9. *What is a desirable number of components for a quality program?* In developing the components of a quality program, tension will always exist between being thorough and being manageable. You want the components to reflect all the key elements of a successful program. At the same time, you want the number to be manageable. We have found that 8 to 13 components is a workable number. Larger numbers of components become unwieldy.

10. *Profiling program quality sounds as if it is labor intensive. Is it worth the time and trouble?* Only program directors, staff, sponsors, and communities can decide. We obviously think so because we have seen communities use the process to produce programs with sounder and stronger outcomes. How much is it worth to you to have a program that comes close to matching what research and expert experience say is a quality program from the beginning? Would you rather wait until problems arise, or prevent them from occurring? How much value is added by your having a competitive advantage in submitting a proposal for outside funding? We believe that calls for increased accountability will require programs to demonstrate their quality and effectiveness, but you have to answer questions like these for yourself.



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3

Designing a Quality Program

Program quality comes more from design than from serendipity. Directors, staff, sponsors, and communities wanting quality programs can achieve their desire, if they take steps to ensure that certain components are inherent within their programs. These are the components of effectiveness described in Chapter 2, "Identifying the Components of Quality Programs." These components represent the best of what we know from research and accumulated experience.

It is crucial that directors, sponsors, and community hold the same expectations for a program intended to help improve science and mathematics education. Our approach to building common expectations of program quality is developing a profile of the program's design and comparing it with the profile of a quality program (see Figure 3.1). This is the first stage of *profiling program quality.* This stage systematically examines and describes a program's components, descriptor by descriptor, and compares them with those of a quality program based on research and expert experience. The process is equally valuable for developing a new program or for improving an existing program.

This stage of *profiling program quality* accomplishes five things. First, it supports building a common language for stakeholders so that discussions about the programs are authentic. Second, it fosters consensus building around program expectations among program directors, staffs, participants, sponsors, and communities. Third, it particularly helps sponsors sort out

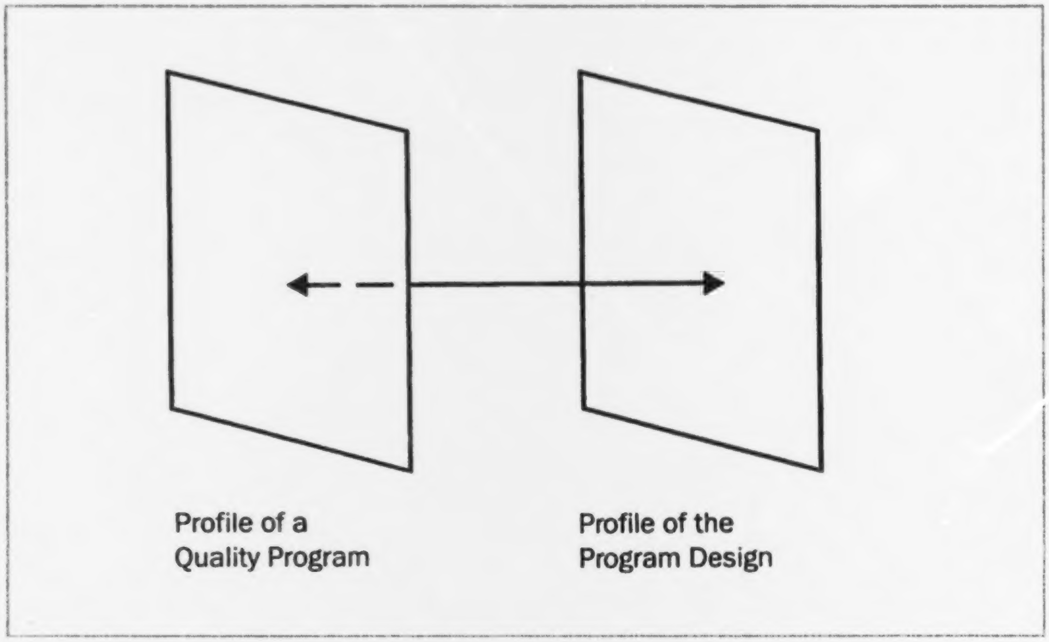


Figure 3.1 Comparing a Program Design With a Quality Program

programs with the greatest potential for success because they reflect what we know works from research and expert experience. So, it guides sound financial program investments. Program design becomes the benchmark against which performance is monitored, and progress reports are issued and discussed. Fourth, it enables program directors to proceed with confidence, and this confidence is shared by sponsors and communities. All believe that they are investing in success. Fifth, it serves as the road map for continual program improvements.

Developing the profile of a program's design and comparing it with that of a quality program is not difficult, even with limited resources. We developed the profiles of quality programs for this purpose. They are tools that program directors and sponsors use to compare the two profiles. Resources F through M of this book are examples of actual program designs for specific components profiled against those of quality programs.

This chapter, "Designing a Quality Program," illustrates for program directors, sponsors, and communities each step in developing the profile of a program design and comparing it with that of a quality program. Chapter 4, "Operating a Quality Program," illustrates the second stage of *profiling program quality:* comparing the operation of the program to both the design and the components of a quality program.

WHAT DOES IT MEAN TO COMPARE PROGRAM PROFILES?

The components of a quality program (for a specific type of program), when fully described, form the *profile of a quality program.* The program director's response to each forms the *profile of the program design.* Here is an example.

> When Laura decided to design an exercise program for herself based on fitness and conditioning guidelines, she asked herself the following questions: What types of exercises are effective? For how long? How often?
>
> After reading exercise literature and talking with a trainer, Laura concluded that a quality exercise program has at least three components: (a) aerobic exercise, (b) weight-bearing exercise, and (c) stretching exercise.
>
> Laura then set out to describe each component according to fitness and conditioning research guidelines and the experience of fitness specialists. She had to decide what *aerobic* means, which physical activities are aerobic, what levels of intensity are required for aerobic benefits, which are good weight-bearing exercises, which stretching exercises are necessary, and for how long. Finally, she had to adjust these descriptors for herself—a beginner. When finished, Laura had the profile of a quality beginner's exercise program based on research and expert experience.

Laura's work to this point is analogous to the result of our work over the past 15 years for programs that support science and mathematics education—teacher development, teacher research, student enrichment, and systemic programs. Now, Laura is ready to *translate* each of these into a personalized exercise program for herself. The following profile displays Laura's translation of the components of a quality exercise program for beginners into her own personal program.

Profile of a Quality Exercise Program	*Profile of Laura's Exercise Program Design*
1. Aerobic Exercise	1. Aerobic Exercise
a. Participate in 20 minutes of aerobic exercise	a. Participate in instructor-led exercise for 30 minutes
b. Participate at least three times a week	b. Attend low-impact aerobics class at gym on M-W-F

(Continued)

Profile of a Quality Exercise Program	*Profile of Laura's Exercise Program Design*
2. Weight-Bearing Exercise	2. Weight-Bearing Exercise
a. Participate in some form of weight-bearing exercise for upper and lower body	a. Complete three sets of 12 rotations each (upper body) and 15 rotations each (lower body) on 15 machines
b. Participate at least three times a week	b. Complete weight-bearing exercises on T-Th-Sat
3. Stretching Exercise	3. Stretching Exercise
a. Stretch upper and lower body	a. Complete five upper body and five lower body stretches; do each stretch five times, holding the stretch for a minimum of 10 seconds
b. Stretch before and after aerobic or weight-bearing exercise	b. Do both before and after exercise

What Laura did was define each component and descriptor of her exercise program as a reflection of the corresponding component of a quality program. She could then evaluate her exercise plan before jumping into the middle of it. In this way, Laura ensured that she had designed an exercise program based on the current knowledge base. And, as such, it was an exercise program with the greatest potential for success.

This process is similar to what a community does when it wants to design a program supporting science and mathematics education or investigate the potential of an existing program. The community has to translate each component of program quality into a component of its own program. It looks self-evident, but it is complex.

HOW DO WE USE THE COMPONENTS OF QUALITY PROGRAMS TO DESIGN A NEW PROGRAM?

Science and mathematics program directors and sponsors consciously design new programs to reflect all the components of a quality program. We have found that the design process has three steps:

1. *Choose a type of program.* We examined four types of programs intended to help improve science and mathematics education: (a) teacher development, (b) teacher research participation, (c) student enrichment, and (d) systemic programs. The four have some components in common; other components are unique to each program. When program directors and sponsors have in mind a type of program different from what we have investigated, they will have to identify the components of quality from research and expert experience. In some cases, the components we have identified can be adapted.

2. *Personalize each component of a quality program to the proposed program.* This step is the substance of the process. The components of quality programs are not a checklist; directors and sponsors cannot just respond by checking "yes" or "no." They must *translate, interpret,* and *personalize* each component to suit a specific program context and environment. This step includes gathering information about the program's context and current expectations. It also entails becoming familiar with the research and expert experience knowledge base for quality programs. This translation must be made without violating or changing a component's intent. The result of this step is narrative descriptions of the new program that correspond to each component of a quality program.

3. *Develop a consensus of all parties interested in the new program.* This step actually functions throughout the design process and depends on joint planning and understanding of expectations.

Each of these steps is considered in more detail below.

Step 1: Choose a Type of Program

Selecting a program is the first step. That program can be a teacher development, teacher research, student enrichment, or systemic program or one similar in nature (see Chapter 2 for a full description of each of these programs).

If directors and sponsors are proposing a program of one of these four types, then the components of a quality program exist. If the program is very similar (e.g., focuses on technology), directors and sponsors can use the components with some modifications. Details on how to modify existing components of quality programs are discussed in Chapter 2.

Step 2: Personalize Each Component of a Quality Program to the Proposed Program

Personalizing each component is the second step. Completing this step successfully—which is the substance of designing a quality program—requires that program directors and sponsors fully understand the components of quality programs. Most components reference terms that are not always interpreted the same by all parties. This is best illustrated through actual examples dealing with the types of programs we examined.

For example, in the profile of quality teacher development programs (outlined in Resource A), two descriptors are related to cooperative and collaborative learning:

- *Teaching and learning are cooperative and collaborative* (1.d). This is a descriptor of the component *vision for the teacher's classroom.* The descriptor describes the program's expectation for how the teacher will teach in his or her own classroom.
- *Opportunities are included for teachers to work together as they learn and plan for transfer to their individual classrooms* (2.g). This descriptor comes from the *program activities* component of teacher development programs and describes how teachers carry out their work in the program itself.

A common instructional technique is having learners (adults or young people) work in groups. In cooperative and collaborative learning, however, a particular pedagogy is involved in choosing people to be in a group; in procedures for the group to carry out its work, including how group members and different groups interact with one another; and in assessing the work of individuals and the group as a whole. It is a highly structured process with very specific outcomes.

Often, program directors and sponsors confuse having people in groups with cooperative and collaborative learning. Therefore, they think they have incorporated this descriptor when they have not.

Here is another instance, this time from quality student enrichment programs (see Resource C):

- *Program establishes relationship with student's teacher, school, and/or district* (3.e). This descriptor is part of the *preparation* component.

The key to understanding this descriptor is knowing what "relationship" entails. Sending out recruiting letters is not establishing a relationship with a student's teacher, school, and/or district. That involves much more: a program director or staff member meeting with school officials, showing a school or district how the student enrichment program can supplement the existing curriculum, having the input of school personnel in planning the program, gathering evaluation data from both the students and their teachers, and more. Notice that the key here is knowing how to define *relationship*.

Here's a third example. This descriptor comes from quality systemic programs (see Resource D):

- *Recruitment and selection of participants are equitable* (7.a). This descriptor is part of the *strategies promoting equity* component.

Often, program directors and sponsors interpret this descriptor as sending out information about a program to schools with high percentages of underrepresented teachers, a technique that rarely results in recruiting a representative pool of applicants. If the program plans to do this, staff believe that they have incorporated the descriptor. They fail to realize that if their approach will not yield the desired results, then it is not a true reflection of the component.

We have identified one paradox of designing a quality program. Although the descriptors defining each component appear simple, they are very complex. Understanding that complexity is what makes translation difficult for many people.

Gaining Clarity About the Components of Quality Programs

Program directors and sponsors can gain a fuller understanding of the components for their own programs by doing one or more of the following:

1. *Studying the components of quality programs from Chapter 2.* No description can explain every key term, such as *cooperative learning*. Directors and sponsors have to agree on an operational definition of these, and the definitions must conform to the research literature and expert experience.
2. *Reviewing the literature base for the components of quality programs.* Resource E provides a list of the literature used in identifying the components of quality programs. Reviewing key sections can help

program directors, sponsors, and communities better understand what the components and individual descriptors mean.

3. *Studying each component in the context of all the components of a quality program.* Often, understanding a descriptor or component in its context is easier than understanding it alone. Prospective users of this book should be familiar with all aspects of the profile of a quality program.
4. *Checking with more experienced program directors and sponsors.* Individuals who have had more extensive experience with similar programs may be able to help interpret descriptors or components that are causing difficulty.

Where Information Comes From

Assuming that everyone understands the components of quality, program directors and sponsors next need to develop a description for their particular program. Developing such a description is part of normal program planning procedures. If designing a summer institute for teachers, the program directors, sponsors, lead teachers, mentors, scientists, and participants themselves should all provide input for the design. Communities use their knowledge of quality programs to guide this planning, as well as to educate community members who may not be as familiar with this concept.

Writing Authentic Responses

When program directors, sponsors, and communities have made their best effort to translate each component of quality programs into a component of the design of their own program, they must ask whether the translation is authentic—whether the description completely portrays how the component will function in the program. To be authentic, descriptions must be specific. This step also is best illustrated through examples.

Next is a descriptor from the *program activities* component of quality teacher development programs: include opportunities to practice new classroom behaviors or strategies (see section 2.f of Resource A). The descriptor refers to teachers practicing new instructional strategies they have learned or other behaviors before returning to their classrooms. They, of course, may do this in a variety of ways. Here are three different translations of this descriptor by actual program directors.

	Profile of a Quality Teacher Development Program	*Profile of the Program Design*
Translation #1	2. Teacher Development Program Activities f. Include opportunities to practice new classroom behaviors or strategies.	2. Teacher Development Program Activities f. Teachers are urged to test each of the 15 activities they develop and to try the inquiry method of instruction.
Translation #2	2. Teacher Development Program Activities f. Include opportunities to practice new classroom behaviors or strategies.	2. Teacher Development Program Activities f. Institute allows extensive opportunity for this. The third week focuses on teacher-directed activities and group work.
Translation #3	2. Teacher Development Program Activities f. Include opportunities to practice new classroom behaviors or strategies.	2. Teacher Development Program Activities f. Sessions focusing on site curriculum will include time to practice and try new things. These sessions will occur daily throughout the institute, accounting for at least 30% of the institute's agenda. Moreover, the institute will be structured to provide 3 years of learning (summer institute days), applying (classroom), analyzing (during school-year institute days and the beginning of the following summer), reapplying on the basis of analysis and mentor input, and so on. This system follows the pattern of good coaching (observe, analyze, and experiment), which can also be used as a self-coaching process through keeping a journal—a tool stressed in the institute.

The third translation is authentic; the first two are not. The third translation stands out for two reasons: (a) It has sufficient detail, and (b) the detail is congruent with effective practice. There appears to be a structure for practice, feedback, and coaching—key components in helping teachers incorporate new behaviors or acquire new skills. (The description could be stronger if "new things" were specified.)

What's wrong with the first two translations? In the first, the verb *urged* is weak and unspecific. Urging teachers to try something is a contrast with providing them with structured opportunities for doing so—followed by feedback. The second translation is similar. It says that teacher-directed activities and group work are the focus of the third week of the institute, but no specific description of how this will occur is provided.

For a second example, look at the *program administration* component of a quality teacher research program (see Resource B). Look specifically at the descriptor: Program goals are clearly stated and understood by all (8.a). Here are two translations of this descriptor.

	Profile of a Quality Teacher Research Program	*Profile of the Program Design*
Translation #1	8. Program Administration a. Program goals are clearly stated and understood by all.	8. Program Administration a. Assume teachers read program literature, which includes goals.
Translation #2	8. Program Administration a. Program goals are clearly stated and understood by all.	8. Program Administration a. Teacher Program Manager (TPM) will meet with each mentor explaining goals of program and reviewing qualifications of teacher participants; TPM and lead teacher will review program goals at orientation with participants.

Which description seems more credible here: the first or the second? Notice that the first translation really indicates no intention to incorporate this descriptor of the component into the program design. In contrast, the second translation indicates that the staff will review and clarify program goals with both mentors and teachers. The second translation is a detailed statement of program intent that reasonably can be assumed will clearly state the program goals so that they are understood by all participants.

We have found that authentic descriptions are:

- *Succinct.* To be manageable, the descriptions need to be relatively brief. If more information is necessary, directors usually attach the pertinent documents as reference.
- *Detailed.* The detail should allow a reader to understand what is really going on in the program with respect to the component. Using shorthand, such as writing "as intended" or "as planned," is insufficient because it does not add detail.
- *Purely descriptive.* The response should simply say what will happen in the program. It should not be evaluative. The evaluative aspect comes in analyzing and interpreting the profiles.
- *Accurate.* Skill is required in condensing information to a few words or sentences. Summaries need to be an accurate reflection of the information.
- *Credible.* The description needs to be believable. It gains credibility through its accuracy, having the appropriate amount of detail, and its objectivity.

Step 3: Develop a Consensus of All Parties Interested in the New Program

Developing a consensus is the third step. This stage of *profiling program quality* has a twofold purpose: (a) to design a program that conforms most closely to a quality program and (b) to establish a common set of expectations between program director and sponsor, between program director and staff, and between the entire program staff and participants representing the community.

Between Program Director and Sponsor

For both clarity of communication and accountability, program director and sponsor need to agree on the nature of the program that will be implemented. For this to happen, the sponsor needs some level of understanding of quality programs, as well as of the proposed program. The director and the sponsor need to concur about components of quality programs that are and are not addressed. Differences of opinion are likely to hinge on availability of resources and may need to be resolved by negotiation. The program director and the sponsor need to agree also on the number, type, and frequency of reports to be submitted during the program design and implementation stages.

Between Program Director and Staff

Clarity and commitment to a quality program are essential for the program director and the staff. Staff members are the individuals who will implement the program. It is crucial for them to understand the components of quality and how to personalize these for their program.

They also need to be committed to the process. Otherwise, they have little motivation to act in a particular manner that will aid effective implementation.

Program staff are likely to be accountable for certain outcomes (e.g., someone coordinates all institute logistics). Therefore, they all need to know, understand, and support their individual tasks. Program sabotage is a possible outcome of lack of commitment.

Staff agreement on a profile of the program design can best come from cooperative planning among colleagues who have an understanding of *profiling program quality.* They, too, need to agree on reporting and debriefing procedures during the design and implementation phases.

Between Program Staff and Participants

Staff can inform participants about the nature of the program in which they are about to participate. Information from a participant needs assessment should have been used in designing the program. Participants need to know how their responses were used and the nature of the program that is about to start. Some adjustments can still be made at this time, if necessary. Participants can profit by understanding the components of quality programs and can observe how the staff apply these throughout the program.

WHAT IF WE ARE RESPONDING TO AN EXTERNAL SOURCE OF PROGRAM FUNDING?

Imagine you're a program director sitting in your office when someone hands you the following Request for Proposal (RFP) and suggests that you start designing a new program to submit for funding. Here is a condensed version of what that RFP might specify:

Teacher Enhancement for High School Science Teachers

Program parameters: An anticipated response to this solicitation for the Teacher Enhancement for High School Science Teachers is a proposal for a 4-week summer institute with follow-up for a maxi-

> mum of 40 high school science teachers. The proposed professional development program should have a regional focus in that it draws local teachers, as well as those from across the state and surrounding states. Teachers will receive stipends of $250/week and have their living expenses covered. If they live within 50 miles of the site where the institute will be held, teachers may commute and be reimbursed for their transportation. At the end of the institute, teachers may submit proposals to receive $500 each to assist them in implementing in their classrooms what they have learned in their summer program. The Teacher Enhancement for High School Science Teachers has been authorized for a minimum of 4 years. After the first year, grantees can apply for and receive multiyear funding, pending satisfactory performance. Priority will be given to teachers coming in pairs from a single school and teachers who are willing to participate for 2 years.
>
> *Program goals:* The program has the following broad goals:
>
> - Increase teachers' knowledge and understanding of science, mathematics, and educational technology (SMET) content, process, and career opportunities
> - Increase teachers' ability to implement "effective practice" in the classroom, which includes accurate science, SMET process, and pedagogy
> - Improve students' intermediate performance outcomes in SMET
> - Increase the extent to which teachers appropriately serve underrepresented populations
>
> *Description of proposal:* . . . this teacher enhancement program must be linked to systemic reform through alignment of program goals, objectives, plans, implementation, follow-up, and evaluation.

So here's the RFP. How do you begin to use the components of quality programs to design your program and write your proposal?

1. *After familiarizing yourself with the RFP and the profile of a quality teacher development program (Resource A), determine the desired outcomes for your program.* Because a realistic outcome is a change in teachers' classroom behavior, think about what you want teachers to do differently after having completed your program. At the same time, look at the descrip-

tors making up the *vision for the teacher's classroom* component of quality teacher development programs. You might envision your teachers:

- Teaching fewer topics in much greater depth
- Facilitating learning in the classroom, rather than delivering instruction
- Relying more often on the inquiry approach to learning and using more hands-on activities
- Using materials, techniques, and approaches that take into account diversity in learning styles and race/ethnicity

2. *Develop goals for your program that reflect your vision for the teacher's classroom, making sure they respond to the goals in the RFP. Here is a set of goals that match those of the RFP:*

- Teachers will exhibit an increased knowledge and understanding of secondary science content, science process, and career opportunities in science for high school students
- Teachers will strengthen their skills in implementing effective practice, science process, and pedagogy
- Teachers will expand their range of skills in serving African American, Hispanic, and Native American students

3. *Once you know what you want teachers to do, determine the essential aspects of your program that will prepare them to do what you want.* Now you are ready to begin sketching out your program. We are talking about what the specific activities are, who is conducting them, and how and when they are going to be done.

The result of this step is a tentative agenda or schedule of events for the 4-week institute, with topics and times. Review your activities in the light of your program goals (will these activities enable you to meet your goals and achieve your desired outcomes). You will also want to review your activities against the following three components of quality teacher development programs (see Resource A): *teacher development program activities, follow-up,* and *teacher leadership and responsibility.* Here are examples:

Profile of a Quality Teacher Development Program	*Profile of the Program Design*
2. Teacher Development Program Activities	2. Teacher Development Program Activities
a. Model elements of the vision of the classroom through . . . sensitivity to diversity.	a. Days 4 and 5: Diversity in the Science Classroom. Two workshop options: Clash in Cultures: The Study of Science and Race/Ethnicity, Sex, and Religion; or Analyzing Texts and Other Instructional Materials in Science for Bias and Stereotyping. Teacher work groups: How can we better accommodate diversity within our classrooms? Report-outs to total group.
4. Follow-up	4. Follow-up
a. Learning activities for teachers are spread out over time.	a. Follow-up for Year 1 will consist of five sessions. Two will be interactive teleconferences involving all institute participants; the others will be three regional meetings. The focus of each event will be to review teachers' prior learning and their experience in practicing new behaviors. New content will also be introduced.

4. *Look at what aspect(s) of your program will address systemic reform.* This RFP has specifically requested that your program address systemic reform in some way. Your most likely role is one of supporting a systemic reform effort ongoing in your state, region, or local area. You could be providing part of the teacher development for that larger effort. If so, descriptors *a* and *b* of the *systemic connections* component can give you guidance in conceptualizing your role in a larger systemic reform effort.

Another aspect of being systemic is alignment of your program with the national science standards and the state's science frameworks, along with the internal alignment of the different aspects of your program (e.g., goals, activities, assessment).

Here's an example of how this proposed program can address the systemic issue:

Profile of a Quality Teacher Development Program	*Profile of the Program Design*
6. Systemic Connections	6. Systemic Connections
b. The program promotes continued use of what participants learn by: • Teachers attend in pairs or teams	b. Teachers from the same school attend in a group of three to five. One team member must be the chair of the science department. Teachers regularly convene in their teams to carry out various institute tasks, focusing on transfer of the learning of the program to the classroom.

5. *Determine your organization's specific contribution to conducting this institute.* Most programs that support mathematics and science education are conducted by organizations other than K-12 schools. Sponsors may be postsecondary institutions, federal or state agencies, business and industry, or private foundations. Often, they have to justify why they want to conduct this institute, along with their capability to do so.

Most proposals require some sort of capability statement. In preparing to write that section, you need to know your capability, part of which is your unique contribution. The *unique contribution of the host organization* component can guide you in determining what contribution only you can make to this institute.

Profile of a Quality Teacher Development Program	*Profile of the Program Design*
3. Unique Contribution of the Host Organization	3. Unique Contribution of the Host Organization
c. Scientific and mathematical focus of the host institution is reflected in teacher development activities.	c. The primary focus of the host institution is robotics. Each teaching team, in conjunction with staff, will design and build a small robot.

6. *Decide on an evaluation plan for your institute.* More and more sponsors are asking grantees to demonstrate results. Notice that this RFP

will grant funding for multiple years if the grantee shows satisfactory performance. To demonstrate satisfactory performance, you need to evaluate your institute on several levels. The component *program evaluation* sets forth these different levels.

Profile of a Quality Teacher Development Program	*Profile of the Program Design*
8. Program Evaluation b. Participants have opportunities to provide feedback and input during and after the experience.	8. Program Evaluation b. Twice a week, small focus groups with revolving membership meet with program staff to discuss any issues and resolve any problems. The program director will chair these groups.

7. *Determine how you want to manage your institute.* Perhaps your organization already has standard operating procedures for project management. You will certainly draw on those, but you will want to add other aspects that are unique to your institute. The *program administration* component can help you do that. Here's an example:

Profile of a Quality Teacher Development Program	*Profile of the Program Design*
7. Program Administration d. Includes teachers, scientists, mathematicians, engineers, educators, and administrators in program design.	7. Program Administration d. The planning team for this proposal has consisted of one scientist, one science educator, one district-level administrator, and one retired teacher. This group will be expanded for the actual program planning by adding. . . .

8. *Put together a budget, and you've got all the sections of your proposal.* You may chose a different order for your text (usually to conform to the review criteria), but everything is there. You can assign your colleagues different sections for writing, or you or someone else may take on the first draft alone.

TABLE 3.1 Comparison of Proposal Requirements With Components of Quality Teacher Development Programs

Proposal Summary	*Components of a Quality Teacher Development Program*
Executive Summary	No specific component
Introduction	No specific component
Problem Statement or Needs Assessment	Program Administration
Program Goals/Objectives	Vision for the Teacher's Classroom Program Administration
Plan of Operation	Vision for the Teacher's Classroom Teacher Development Program Activities Follow-up Teacher Leadership and Responsibility Systemic Connections
Management Plan	Program Administration Systemic Connections
Institutional Capability	Unique Contribution of the Host Organization
Evaluation	Program Evaluation
Budget	Program Administration

Once you have a draft of your proposal, you will want to go back and double-check it against all the components of quality teacher development programs (see Resource A).

Table 3.1 is a comparison of the typical sections of a proposal (left-hand side) with the components of quality teacher development programs that are relevant to that section.

HOW DO WE USE THE COMPONENTS TO LOOK AT A CURRENT PROGRAM DESIGN?

Perhaps the organization has conducted a specific teacher development, teacher research, student enrichment, or systemic program for several years and is interested in assessing the quality of the program design. We mentioned earlier that *profiling program quality* can be used for improving existing programs, as well as for guiding the development of new ones. The process is only slightly different.

Instead of starting anew, directors and sponsors compare the current program design with the components of a quality program. They look to see whether the current program design reflects a quality program. This process has three steps if the director and sponsor have completed the steps necessary to develop the profile of the program design (see the section "How Do We Use the Components of Quality Programs to Design a New Program?"):

1. *Compare the profile of the program design with the profile of a quality program of the same type.* We use the profiles of quality teacher development, teacher research, student enrichment, and systemic programs, found in Resources A through D. We suggest placing the two profiles side by side in two columns.
2. *Rethink any parts of the program design that do not reflect the components of a quality program.* There are always differences between a particular program and one reflecting all the components of quality programs. Some differences may be irreconcilable because of organizational commitment or context. Others occur because of deficits in thinking through a program design completely. The first type of difference must be noted; the second type should be removed.
3. *Refine the profile of the program design.* Directors and sponsors should remove as many differences as possible between the profile of their program design and that of a quality program.

Each of these steps is described more fully below.

Step 1: Compare the Profile of the Program Design With the Profile of a Quality Program of the Same Type

Program directors complete the description of the new or proposed program for each component—descriptor by descriptor. Usually, program directors do this in consultation with staff, participants, and sponsors. One or several meetings are often held for this purpose. Another option is for program directors or staff members to confer with the others, complete the descriptions, and then review them with the design team.

It is possible to gather information from program staff to write descriptions of what the existing program intends to do. Other good sources of

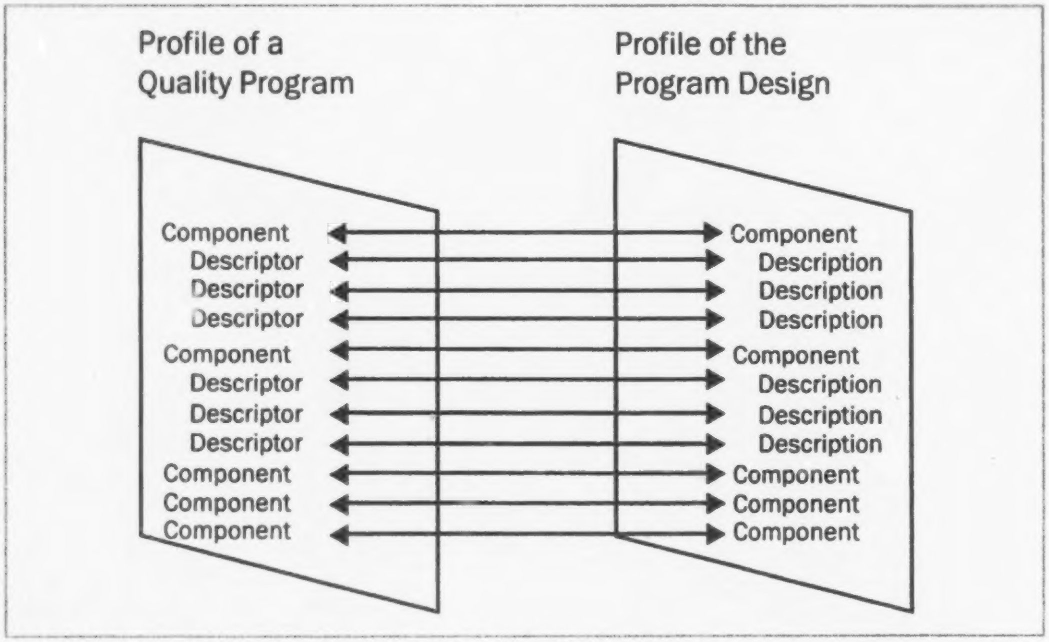


Figure 3.2 Comparing Each Component and Descriptor of the Program's Design With Those of a Quality Program

information are brochures, recruiting materials, schedules, interim reports, and other written materials about the program.

Another way of gathering the necessary information is to convene a group of people, all of whom are very knowledgeable about the program. These people use a combination of small- and large-group activities to compare the current program design—component by component, descriptor by descriptor—and report on its findings. A recorder can note areas of disagreement.

Although we usually do not recommend this, it is possible to use the components as a checklist. It can give a very quick and cursory assessment of the extent to which an existing program reflects the components of a quality program.

We suggest placing the two profiles side by side in two columns for review and discussion. The left column is the profile of a quality program. The right column is the profile of the program design (see Figure 3.2). The following exhibit displays this comparison for the *vision for the teacher's classroom* component for teacher development programs (see Resource A). Resources F through M contain several samples of program designs profiled against corresponding components of quality programs for each type of program we examined.

Profile of a Quality Teacher Development Program	*Profile of the Program Design*
1. Vision for the Teacher's Classroom	1. Vision for the Teacher's Classroom
a. The content of teaching and learning is: • Big ideas in science and mathematics • Scientific attitudes • Scientific and mathematical skills	a. The institute is designed so that participants explore scientific principles such as classifying materials as metallic or nonmetallic, crystalline or amorphous, chemical bonding or crystal structure, and understand such properties as mechanical strength, thermal and electrical conductivity, and polarization. Teachers will encourage students to use skills such as experimenting, problem solving, and handiness* through designing, fabricating, and producing projects. Through experimentation, problem solving, and projects, teachers will be able to foster the understanding of the links among ceramics, glass, polymers, metals, and composites. The in-depth study of the nature, properties, behaviors, and applications of materials will assist students in making the connections of science, mathematics, engineering, and technology to their world. (*Handiness is the ability to solve materials-related problems with available or limited resources.)
b. The process of teaching and learning is a "hands-on/minds-on" instructional approach that includes student investigation, discovery, and application of relevant science and mathematics.	b. Teachers will use a multi-instructional approach in their classrooms so that all students can be successful. This approach includes team teaching, guiding of student projects, students working in groups, problem solving, using a laboratory journal as a tool for learning, creativity and risk taking being fostered, students developing handiness, and using community resources.

(Continued)

Profile of a Quality Teacher Development Program	*Profile of the Program Design*
c. Teacher's primary roles are facilitator, coach, and mediator.	c. Teachers will function more as facilitators, coaches, and mediators than as authorities with all the right answers who impart knowledge to students.
d. Teaching and learning are cooperative and collaborative.	d. Participants will conduct much of their work in a cooperative group. All work will be done in a collaborative manner among the scientists, mentor teachers, and participants.
e. Teachers use materials, strategies, and perspectives sensitive to diverse: • Cultures • Languages • Genders • Learning styles	e. Multi-instructional approach demonstrates strategies that reach all students.
f. Teachers and students engage in ongoing authentic assessment of important learning outcomes.	f. Teachers begin to develop alternative assessment strategies such as examining student journals, projects, research papers, oral presentations, and laboratory observations.
g. Other. (Emphasis on linkage of creativity with practical reasoning.)	g. Activities foster imagination and fantasy as pathways to creativity and innovation while at the same time emphasizing step-by-step practical reasoning to solve problems.

Step 2: Rethink Any Parts of the Program Design That Do Not Reflect the Components of a Quality Program

The second step is to review the components, descriptor by descriptor, looking for differences. These are instances where the component of quality programs and the description of the program design do not match at all or do not match well. These descriptors indicate areas in which the program does not reflect research and expert experience. The program directors and sponsors should rethink these descriptors together. Frequently, program directors submit a program design report to the sponsors for this purpose.

The report is simply the comparison of the two profiles where differences are marked for discussion.

Review the previous example of the profile of the design of a teacher development program with that of a quality program with respect to the *vision for the teacher's classroom.* This component has been the most difficult for program directors and staff to capture. Because teacher development programs are intended to influence teachers' classroom behavior, descriptors in the profile of the program design are the program staff's vision of what teachers will do when they return to their schools. There is also an underlying assumption that teachers need to learn the way the program wants them to teach their students. As a result, *teacher development program activities* need to be reflexive.

This example of comparing the program's design with that of a quality teacher development program does a reasonably good job of capturing the essence of the *vision for the teacher's classroom.* It is not exemplary, however. The program design description of how teachers use materials, strategies, and perspectives sensitive to diverse cultures, languages, genders, and learning styles (Resource A, descriptor 1.e) lacks detail. A reader has no idea what the program intends to do to address this issue.

Step 3: Refine the Profile of the Program Design

In the third step, program directors and sponsors should revise components or descriptors of the profile of the program design until they reflect the appropriate component of quality programs. In the previous example of the description of how the program intends to use multicultural materials, strategies, and perspectives, program directors and staff can now rethink and rewrite this description to reflect more fully a quality teacher development program.

Sometimes the differences between the program design and a quality program cannot be resolved. There are numerous valid reasons: lack of funds, lack of trained personnel, and absence of suitable facilities. Or perhaps it is a multiyear program, developmental in nature; some descriptors of certain components are not intended to occur until Year 2—maybe even Year 3.

Program directors and sponsors need to indicate *clearly* the aspects of the program that will not operate according to the components of quality programs and why. Program directors should not be held accountable for something they cannot, or chose not to, do as long as there is a valid justification.

In any event, the product of *profiling program quality* to this point is a program design that conforms to or reflects the profile of a quality program to the maximum extent possible. And where the profile of the program design does not conform, it is noted with a reason.

WHY SHOULD WE USE THIS APPROACH TO PROGRAM PLANNING AND DESIGN?

The first chapter in this book puts forth a variety of reasons why basing a program on the components of quality programs is beneficial. We'll reiterate those here briefly.

Profiling program quality will:

- *Result in a better program design.* This is especially true if program directors and sponsors are just getting started in planning and conducting teacher development or other programs.
- *Provide a competitive advantage.* If a community is submitting a proposal for funding a program, it can hold an advantage over the competition by having a comprehensive program, one more likely to yield the desired results.
- *Tell program directors and sponsors whether they should scale up the program.* Should the program be expanded to larger audiences or other organizations? The degree to which the program incorporates the components of quality programs indicates whether the program is suitable for expansion.
- *Prepare program directors and sponsors to conduct an impact evaluation of the program.* Often, directors or sponsors try to determine impact before the program has stabilized. In these instances, the impact evaluation is weakened because outcomes cannot be related to certain aspects of the program. There may or may not have been an impact, but no one knows why. If all—or most—components of quality programs are reflected in the program design, knowing to what to attribute the outcomes will be more likely.
- *Show a desire for accountability on the part of the organization.* By making sure that the components of quality programs are incorporated into the program, the organization demonstrates that it is

interested in running a successful program—not just in conducting a program that it thinks might be good.

- *Save money in the long run.* Before the community spends large amounts of money on implementing, continuing, or scaling up a program, it knows whether the quality of the program justifies the expenditures.

These seem pretty compelling reasons. Why isn't everybody doing it?

WHAT ARE THE CHALLENGES OF USING PROFILING PROGRAM QUALITY TO DESIGN A PROGRAM?

Communities cite numerous reasons for not using the components of quality programs to design their own programs.

Communities may not be aware of the process or the components of quality programs for their type of program; or they simply may not have a research-based orientation to program planning.

Perhaps they have been conducting a program for a long period of time and believe that they don't need any outside help. Or maybe they have to put together a program very quickly and do not think they have the time to review (or research) the components of quality programs.

In addition, the process was originally developed as a tool for formative evaluation of existing programs (see Chapter 4). Only more recently have people begun to use it for planning and design.

Lack of commitment is another reason. Unless people know firsthand the value of using the components of quality programs in designing and implementing their own programs, they are unlikely to allocate time and money to the process. This lack of commitment applies particularly to program sponsors—those individuals and groups with oversight responsibility. Glance again at the section of this chapter "What If We Are Responding to an External Source of Program Funding?" The proposal requirements advertised by the sponsor do not reflect the components of quality programs completely. Specifically, no references are made to *vision for the teacher's classroom* (what instruction should look like) or to the type of *program evaluation* required. Sponsors must be clear about their requirements, and these should reflect the components of what we know to be quality programs.

The major challenge, however, which we have identified through helping directors and sponsors use *profiling program quality* with hundreds of programs, is translating the components into their own programs.

Earlier in this book, we discussed the process of personalizing each component of a quality program to a proposed program. We gave numerous examples and discussed how difficult making the transition is for many people. We also mentioned what to do to make the process easier.

The reality is that using the components to design and operate a program is not, for most people, a self-taught process. Training or technical assistance or both may be necessary for program directors and sponsors to acquire the knowledge and skills necessary to use the process effectively. NCISE offers such training and technical assistance. If you are interested, contact NCISE in Washington, D.C., at 202-467-0652.

WHO SHOULD BE INVOLVED IN THIS STAGE OF PROFILING PROGRAM QUALITY?

Program directors, sponsors, and community members should all be involved to some extent, although their roles are somewhat different. The major task of designing a program in response to each component of quality usually falls to program directors, together with their staff. A director or a single staff member can complete this stage working alone, but we do not recommend it. Few persons have the breadth and depth of knowledge to do so solo. A better approach is to draw on the wisdom and experience of the community involved in conducting the program, and this includes especially participants.

A frequent proposal requirement in response to outside funding is demonstrating that the proposed program is based on a needs assessment. *Profiling program quality* is a perfect way to conduct this assessment and to build the results into the program design. The process will take longer, but the end product will be better and build ownership of, and commitment to, the program on the basis of common expectations.

Sponsors play a key role in detailing the program requirements. Requesting a program that "enhances science and mathematics education" or "increases student achievement" is insufficient. Program requirements should include clear statements about each component of a quality program. In this way, sponsors set the tone and expectation that the eventual program will have the greatest potential for success. A primary benefit of *profiling* *program quality* is that the process provides a common language for program directors and sponsors to discuss their programs.

WHAT QUESTIONS ARE FREQUENTLY ASKED ABOUT THIS STAGE OF PROFILING PROGRAM QUALITY?

General Questions

1. *Why is it so difficult to write descriptions of the program design that are authentic? The components seem self-explanatory.* You are absolutely right: The components do appear to be self-evident. Therein lies the problem: They are not. What looks simple is actually very complex. Failure to understand the complexity is the biggest challenge in translating the components into a new program design. In this book, we list five criteria for writing an authentic description: that the description is *succinct, detailed, purely descriptive, accurate,* and *credible.*

Most often, program directors and staff err by writing descriptions that lack sufficient detail and that are evaluative. The detail must be sufficient for someone not directly involved with the program on a day-by-day basis—say, a sponsor—to understand what will be occurring in the program. And it should not reflect opinion or qualitative judgments about the component. Judgments are reserved for comparing the profile of the program design with that of a quality program. Even then, judgments are confined to congruencies and differences between the two profiles. The description functions like a good newspaper account—"Just the facts, ma'am, just the facts."

2. *Can a program director or staff member just go into an office, shut the door, and write descriptions of a program design all alone?* Sure, anything is possible. One can do so, but we do not recommend it. Few persons have the breadth and depth of knowledge to do so solo. A better approach is to draw on the wisdom and experience of the people involved in planning and conducting the program. The process will take longer, but you will have a better end product and will have built ownership in using it.

3. *Is it better to use profiling program quality for designing a new program or for investigating an existing one?* It really doesn't make any difference. The main advantage in using the process with new programs is the capacity to design a quality program from the beginning. You are

discovering and working out major problems beforehand, rather than after the fact.

Questions Related to Writing a Proposal for External Funding

1. *If everyone were to follow profiling program quality, wouldn't all proposals look alike?* No, the components can be translated into an infinite number of different program designs. Moreover, some proposal writers will do a better job of capturing the essence of quality programs, especially in the light of sponsors' goals. The possibility exists that the competition could turn out to be stiffer, but we are a long way from that happening. All other things being equal, you should have the competitive advantage.

2. *Does this process for developing proposals change with the type of program?* Basically, no. You follow the same steps. Because systemic programs are, by their nature, more complex than, say, student enrichment or teacher development programs, the planning process is likely to be more complicated and time-consuming and to involve more people. The process, however, remains the same.

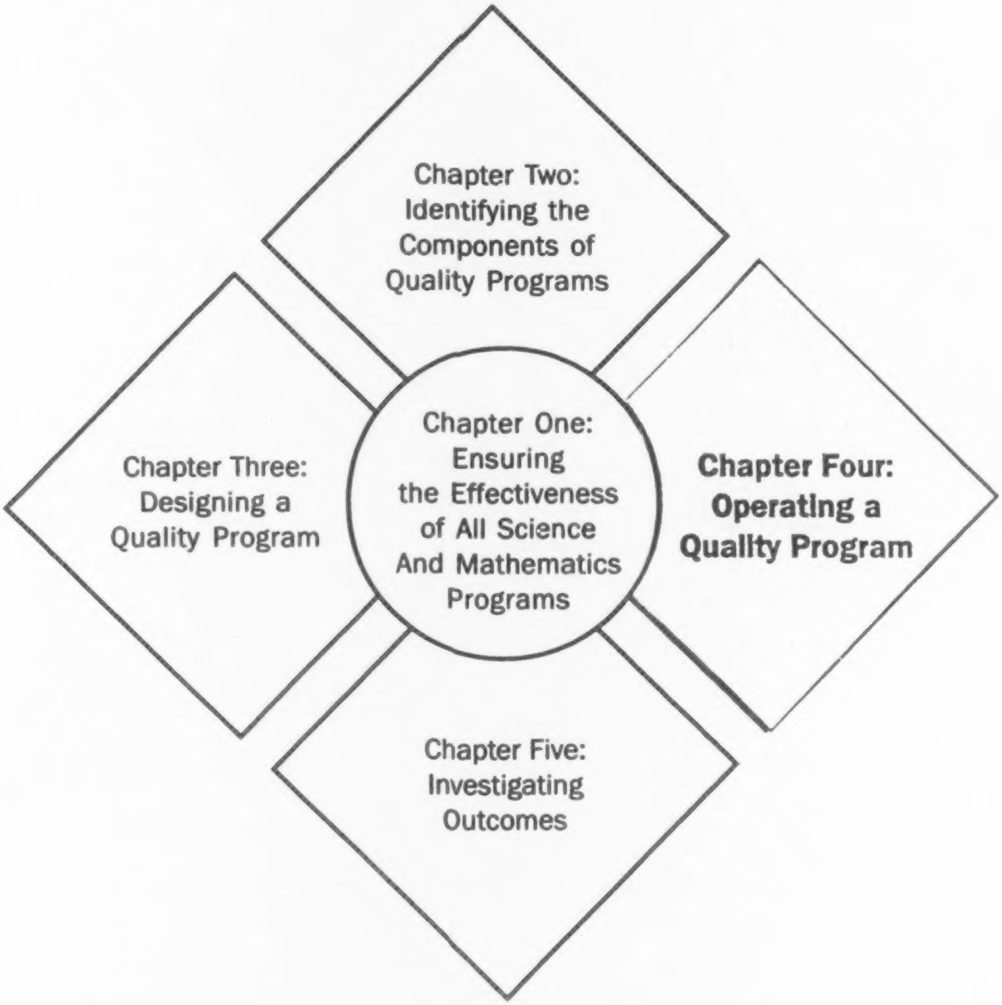
3. *What if I omit one or more components of quality programs, or descriptors, in my program planning?* We can think of numerous reasons why you might choose to omit a component in planning your program, but it is never a good idea. Every component you fail to include indicates a weakness in your program design that will filter through to the program outcomes. Program designers should not omit components from design consideration without explaining the decision.

When writing a proposal for outside funding, however, you might have a rationale for omitting a component. One, the RFP might not mention the component, and you do not want to confuse a sponsor's readers or the decision-making group. Two, the RFP might ask you only to describe the first year of the program's operations but you plan to address the component in Years 2 or 3. Three, omission of some descriptors of a component in a proposal would not be a problem.

4. *What if a sponsor does not know about profiling program quality?* Here is the perfect opportunity for you to provide information. You can say in your proposal that your program design incorporates the components of quality programs based on research and expert experience. These components have been identified and delineated by NCISE and are fully docu-

mented. That may very well pique interest, and you can proceed from there. A possible next step might be giving the sponsor a copy of this book, marking Chapter 2 especially.

5. *Will profiling program quality take more work?* Not necessarily. The amount of time it will take depends on the knowledge and skill of your program staff and proposal writers. Because the components are such good guides, however, it actually could take less time.


Chapter Two: Identifying the Components of Quality Programs
Chapter Three: Designing a Quality Program
Chapter One: Ensuring the Effectiveness of All Science And Mathematics Programs
Chapter Four: Operating a Quality Program
Chapter Five: Investigating Outcomes

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4

Operating a Quality Program

Plans change. Expectations are rarely carried out in reality. So, it is not enough to *design* a quality program. Directors, sponsors, and communities must continue their oversight and investigation as their programs unfold into operations. This investigation is the second stage of *profiling program quality*.

The questions to be answered are these: What is actually going on in the program? and How does this compare with a quality program? Without the answers to these questions, it is impossible to know what is causing either desired or unexpected program outcomes. Likewise, it is impossible to know exactly what to change to improve the program.

In Chapter 3, "Designing a Quality Program," we introduced the concept of comparing the profile of the program design with that of a quality program based on research and expert experience. This is a way to build in the potential for success and effectiveness before operations begin, before a program consumes significant resources, or before the opportunity to improve science and mathematics education is lost.

In this second stage of *profiling program quality*, the comparison is extended to include program operations. Now, three profiles need to be developed and compared: (a) the profile of a quality program, (b) the profile of the program design, and (c) the profile of the program in operation (see Figure 4.1).

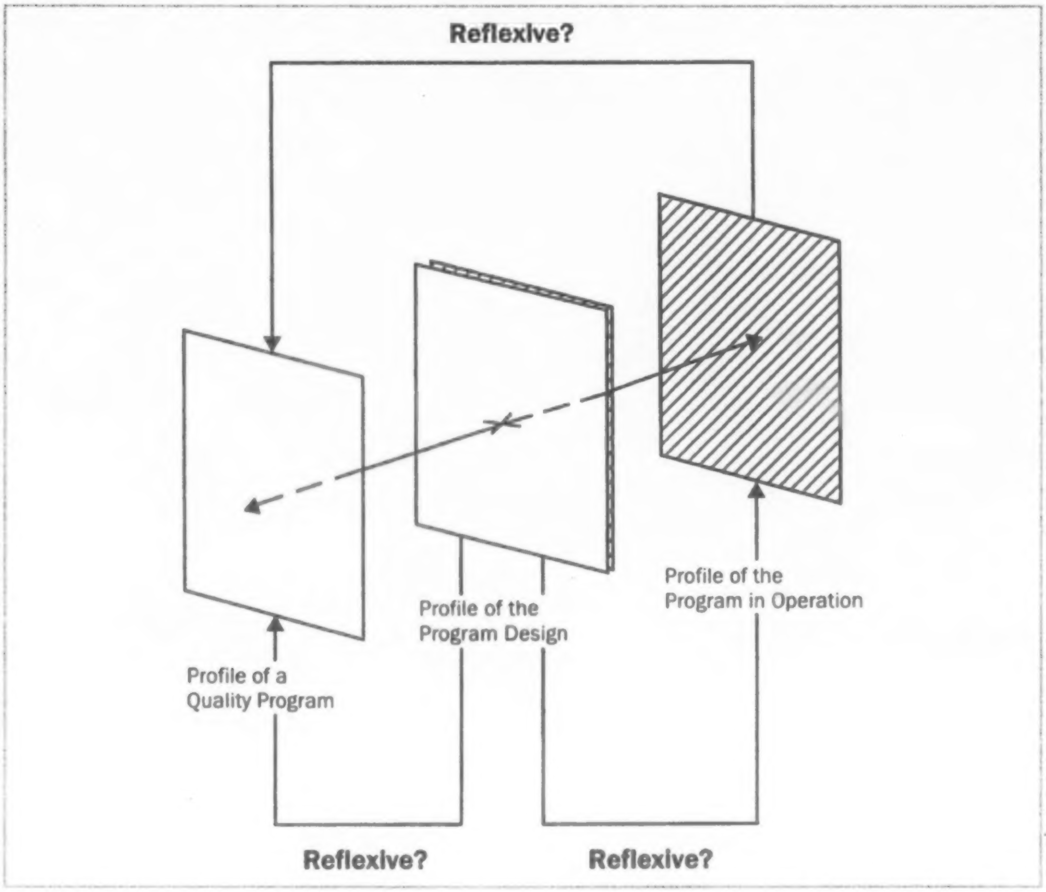


Figure 4.1 Reflexiveness of Program Design, Operation, and a Quality Program

These comparisons lead to one of four conclusions:

1. *The program in operation reflects both its design and a quality program.* The program is operating effectively; the potential for desired outcomes is greatest.
2. *The program in operation reflects neither its design nor a quality program.* You have redesign to do and changes in operations to make until the design and operations both reflect a quality program.
3. *The program in operation reflects a quality program, but its design does not.* The program is operating effectively despite weaknesses in its design. The design must be strengthened.

4. *The program in operation does not reflect its design; the design does, however, reflect a quality program.* In this case, the intention was clear, but something happened during implementation. This difference is very common.

In any event, the actions of the program directors, sponsors, and community are clear. To improve the program, they must either strengthen operations, strengthen the program design, or both.

This stage of *profiling program quality* points out to program directors, sponsors, and communities exactly how to strengthen the operations of their programs so that the programs reflect all the components of quality. This stage guides program improvement. It uncovers what is actually going on in a program and compares it with a quality program.

This chapter, "Operating a Quality Program," illustrates each step in developing the *profile of the program in operation* and in comparing it with the profiles of the program design and of a quality program so that improvements can be made wisely. The Resources at the end of this book contain examples of various components of actual programs where the profiles of the programs in operation are compared with their designs and the profile of a quality program of that type.

WHAT DOES IT MEAN TO COMPARE THREE PROGRAM PROFILES?

To illustrate the concept of comparing profiles, we return to the example of Laura's personal exercise program from Chapter 3.

> Laura designed for herself a personal exercise program based on fitness and conditioning guidelines developed through research and expert experience. She found that a quality exercise program had three components; she built these into her program design—descriptor by descriptor.
>
> So, how is Laura doing? What is her actual exercise program? What's going on?
>
> To answer these questions, Laura kept a weekly exercise diary. Entries from her diary, along with the profiles of a quality exercise program and Laura's program design, are displayed in the following profile:

Profile of a Quality Exercise Program	*Profile of Laura's Exercise Program Design*	*Profile of Laura's Exercise Program in Operation*
1. Aerobic Exercise	1. Aerobic Exercise	1. Aerobic Exercise
a. Participate in 20 minutes of aerobic exercise	a. Participate in instructor-led exercise for 30 minutes	a. Participated in instructor-led exercise for 40 minutes
b. Participate at least three times a week	b. Attend low-impact aerobics class at gym on M-W-F	b. Attended low-impact aerobics class at gym on M-W-F
2. Weight-Bearing Exercise	2. Weight-Bearing Exercise	2. Weight-Bearing Exercise
a. Participate in some form of weight-bearing exercise for upper and lower body	a. Complete three sets of 12 rotations each (upper body) and 15 rotations each (lower body) on 15 machines	a. Completed three sets of 12 rotations each (upper body) and 15 rotations each (lower body) on 6 machines
b. Participate at least three times a week	b. Complete weight-bearing exercises on T-Th-Sat	b. Completed above on T-Th but not on Saturday
3. Stretching Exercise	3. Stretching Exercise	3. Stretching Exercise
a. Stretch upper and lower body	a. Complete five upper body and five lower body stretches. Do each stretch five times, holding the stretch for a minimum of 10 seconds	a. Completed five upper body and five lower body stretches, five times each, holding stretch for 10 seconds
b. Stretch before and after aerobic or weight-bearing exercise	b. Do both before and after exercise	b. Stretched before exercising but not after

In comparing the profile of Laura's exercise program design with that of a quality exercise program, we see that the design is solid: It reflects each component of a quality exercise program. But what actually happened—Laura's actual exercise activities as reported in her diary—tell a different story. Her actual activities were not totally reflective of either her intentions (design) or a quality program. Specifically,

- Laura got in more aerobic exercise than planned (the program in operation actually exceeds the expectations set forth in the program design), but
- Laura did not complete the weight-bearing or stretching exercises both with respect to her design or effective practice (operations did not conform either to the program design or a quality program).

Armed with this information, Laura and her coach know exactly how to improve her performance: Pay attention to weight-bearing and stretching components, even if this means curtailing her participation in aerobic activities.

Here are two examples from a quality teacher development program. Each example deals with a descriptor of the *teacher development program activities* component (see Resource A, component 2).

Profile of a Quality Teacher Development Program	*Profile of the Program Design*	*Profile of the Program in Operation*
2. Teacher Development Program Activities f. Include opportunities to practice new classroom behaviors or strategies.	2. Teacher Development Program Activities f. Teachers will practice-teach two different lessons using an inquiry-based approach. They will be videotaped and will critique the tape with two colleagues and the program manager.	2. Teacher Development Program Activities f. All teachers taught two different lessons using an inquiry-based approach. Six of the 30 taught a third because they had not exhibited 80% or more of the teaching strategies appropriate for an inquiry-based approach. All practice teaching sessions were videotaped. Some will be edited and used for evaluation and also for recruiting other teachers to the program.

This descriptor calls for opportunities for teachers to practice what they have been learning. The program design intends to provide teachers with two practice sessions in which they will receive feedback. In actuality, all teachers had their two practice sessions, and a few had three. The process appeared to have been worthwhile, and program personnel discovered additional uses for the videotapes. This is a descriptor for which program operations and program design both reflect a quality program.

As we know from our first example, not everything always goes according to plan. Consider this second example:

Profile of a Quality Teacher Development Program	*Profile of the Program Design*	*Profile of the Program in Operation*
2. Teacher Development Program Activities	2. Teacher Development Program Activities	2. Teacher Development Program Activities
f. Include opportunities to practice new classroom behaviors or strategies.	f. Teachers are urged to test each of the 15 activities they developed and to try the inquiry method of instruction.	f. As intended. The teachers were required to teach three activities to their peers. This was very successful.

The description of the program in operation for this descriptor raises questions, rather than answers them. Teaching three activities to their peers does not appear to be the same thing as testing each of 15 activities. Did the three activities reflect the inquiry method? What about the other 12? What role did peers play? For example, did they provide feedback? In this example, it is not clear that either the program design or the program in operation reflects a quality program.

HOW DO WE STRENGTHEN PROGRAM OPERATIONS USING PROFILING PROGRAM QUALITY?

Science and mathematics program directors and sponsors strengthen program operations by developing a third profile—*the program in operation*—and comparing it with the profiles of a quality program and the program design. Differences in components (and descriptors) across the three profiles indicate aspects of the program that must be strengthened by improving program operations, by refining the program design, or both. We have found that this process has five steps for a program of any particular type. Each of the steps is described in the next section.

Step 1: Develop the Profile of the Program in Operation

Step 1 entails gathering information that describes all the components of the program in operation. Program directors and staff gather information that describes the program in operation near or at the end of a program cycle or iteration. For example, if the teacher development program includes a series of workshops for cohorts of teachers, a cycle is the experience of one cohort. If the program is a student enrichment type, then an iteration is the program conducted for one group of students.

Ways of Gathering Information

The sources of information about the program in operation are program directors, program staff, participants, and (sometimes) colleagues of participants. This information may be gathered in several ways. Interviews, observations, and reviews of materials are popular methods.

Interviews with program staff and participants. It is crucial to compare the perceptions of those people conducting the program with those of the people participating in the program. We recommend that someone interview all the program staff and at least 10% of participants but no fewer than eight individuals. Interviews can be one-on-one or conducted with groups of staff or participants. In either case, whoever is gathering the information should select a cross section of people varying on such dimensions as kind of school and attitude about the program. Surveys are not usually effective for this purpose because descriptive statistics such as averages and medians do not tell directors *what actually happened.*

Observations of the program in operation. Directly watching program activities is perhaps the best way to develop the description of what is actually going on. Program directors and staff should observe, whenever possible, to get a sense of the environment, the people, the work, the interactions, the facilities, and the stories. Directors and staff should follow up with questions about their observations to enhance the quality and quantity of information.

This method of gathering information, though beneficial, is also the most costly in terms of time and personnel. Spot checks can be made for less cost by using the profiles of a quality program and the program design as guidelines. Through observation, directors and staff can determine, for example, whether students are actively engaged in learning in a student enrichment program or are sitting listening to a lecture.

Reviews of written materials and other records of program activities. Such documents include any evaluation materials compiled during the program (e.g., daily evaluation sheets), along with participants' work: lesson plans, reports on work accomplished, materials displayed at concluding poster sessions, and action plans developed by participants to guide them in transferring their learning to their classrooms and schools.

Who Gathers the Information

The task of gathering information about the program in operation and developing the profile usually falls to program directors and staff. Sometimes, external consultants are involved and charged with this responsibility. Often, many people are involved.

Whether internal or external personnel gather the information depends on the situation. If program staff do this task, the best option is a small team to help ensure accuracy of the information. If an external consultant comes in to complete the task, she or he may be a professional evaluator or graduate student or other person who works under the close supervision of the program directors. Regardless, the person will follow the same process, although program staff may work more quickly because of their knowledge of the program.

There are possible advantages and disadvantages of using program staff or external individuals to gather the information:

	Program Staff	*External Consultant*
Advantages	• More familiar with the program • Probably costs less money • Can build internal capability	• Greater objectivity • Possibility of finding a highly qualified person
Disadvantages	• Possible lack of objectivity • Lack of adequate experience or training • Insufficient time to complete the task	• Difficulty in finding a qualified person • Unfamiliarity with the program • Greater cost

The internal versus external personnel question has no one right answer. It really depends on each program's needs and resources.

Writing the Profile of the Program in Operation

The guidelines that apply to writing this profile are similar to those for developing the profile of the program design in Chapter 3. Descriptions need to be written for each component and descriptor of the actual program by using the profile of a quality program as a guide.

Descriptions need to be

- *Succinct.* To be manageable, descriptions need to be relatively brief. If more information is necessary, directors usually attach the pertinent documents as reference.
- *Detailed.* The detail should allow a reader to understand what is really going on in the program with respect to the component. Using shorthand, such as writing "as intended" or "as planned," is insufficient because it does not add any detail.
- *Purely descriptive.* The response should simply say what happened in the program. It should not be evaluative. The evaluative aspect comes in analyzing and interpreting the profiles.
- *Accurate.* Skill is required in condensing information to a few words or sentences. Summaries need to be an accurate reflection of the information.
- *Credible.* The description needs to be believable. It gains credibility through its accuracy, appropriate amount of detail, and objectivity.

This step is best illustrated through examples. Here are two examples of profiles of a program design and operation for one descriptor of the component *program administration* for a quality teacher research program (see Resource B). Which is the better description?

	Profile of a Quality Teacher Research Program	*Profile of the Program Design*	*Profile of the Program in Operation*
Example #1	8. Program Administration h. Plans carefully for housing and other logistics (e.g., transportation, information about the community)	8. Program Administration h. Administrator sends information; participants make own arrangements for housing and other local items	8. Program Administration h. As intended

(Continued)

	Profile of a Quality Teacher Research Program	*Profile of the Program Design*	*Profile of the Program in Operation*
Example #2	8. Program Administration	8. Program Administration	8. Program Administration
	h. Plans carefully for housing and other logistics (e.g., transportation, information about the community)	h. Housing information is sent to each participant; efforts are made to house participants together at a local university; information about the community is given to each participant on arrival	h. Teachers stayed together in a new dorm at a local university; some problems arose because of misunderstanding with the university and the poor construction of the new dorm; teachers did not have easy access to telephones; information about community was provided; participants needing travel assistance were accommodated

Obviously, Example #2 comes much closer to meeting the criteria for a credible description. The Resources at the end of this book contain examples of profiles of programs in operation for various components.

Step 2: Compare the Profile of the Program in Operation With the Profiles of the Program Design and a Quality Program

One way to do Step 2 is to place the profiles side by side. This is what we have done with several examples in the Resources at the end of this book, although different formats work as well.

Program directors and sponsors should examine the three profiles (component by component and descriptor by descriptor), looking for congruencies and differences. Sponsors may find one kind of congruency and difference, whereas program directors and staff may find others. This may occur because sponsors have different perspectives on a program than do people with day-to-day responsibilities. Participants in a program, representing the community, are invaluable at this point in the process. What they find to be important probably is.

A *congruency* occurs when a descriptor from the program in operation reflects, or matches, that same descriptor from the program design and from a quality program. A *difference* is where the three descriptions do not match.

Congruencies and differences can take the following forms:

- *The program in operation reflects both its design and a quality program.* Descriptions of a descriptor in all three profiles are congruent. The program intended to incorporate the descriptor into its operations, and it did. This is the ideal.
- *The program in operation reflects neither its design nor a quality program.* This type of difference should not occur if program directors and sponsors are following *profiling program quality.* It may occur, however, when directors and sponsors institute the process for an existing program. Although frustrating to uncover, it just means that redesign must be done and changes in operations must be made until the design and operations both reflect a quality program.
- *The program in operation reflects a quality program, but the design does not.* Although theoretically possible, in reality this type of difference rarely occurs. If it did happen, program directors somehow failed to capture what was probably intended, or something happened during operations that led to a change. The program is operating despite weaknesses in its design. The design must be strengthened.
- *The program in operation does not reflect its design; the design does, however, reflect a quality program.* In this case, the intention was clear, but something happened during implementation. This difference is very common.

Here is an illustration of the forms that congruencies and differences can take. The following examples address the descriptor creates collegial atmosphere, which is part of the component *program administration* for quality teacher development programs (Resource A.7.f).

	Profile of a Quality Teacher Development Program	*Profile of the Program Design*	*Profile of the Program in Operation*
Example #1	7. Program Administration f. Creates collegial atmosphere.	7. Program Administration f. Scientists and teachers collaborate on experiments and projects. Special introductory activities are planned, including a picnic and group lunches. Mentor teachers are housed in the same location as the participants.	7. Program Administration f. Every team consisted of four teachers and a scientist who worked together on each experiment and project. Scientists, mentor teachers, and participants met and got acquainted during a structured mixer the night before the program began. Each Friday, there was a group lunch for all the teams, including the scientists. A hospitality suite was set up at the dorm so that mentor teachers and participants could interact with one another easily. This was used nightly and was very popular with the group. The concluding activity was a presentation of each team's work to all teachers and scientists.
Example #2	7. Program Administration f. Creates collegial atmosphere.	7. Program Administration f. Scientists and teachers collaborate on experiments and projects. Special introductory activities are planned, including a picnic and group lunches. Mentor teachers are housed in the same location as the participants.	7. Program Administration f. Teachers worked in teams of four. A scientist was available for consultation. Scientists were invited to a pre-program picnic; two attended. Mentor teachers were housed with participants.

Example #3	7. Program Administration f. Creates collegial atmosphere.	7. Program Administration f. Scientists are available for consultation as needed. They will join teachers for a group lunch once a week.	7. Program Administration f. Each team consisted of four teachers and one scientist who worked together on each experiment and project. Each Friday, there was a group lunch for all teams, including the scientists, who attended faithfully. The concluding activity was a presentation of each team's work to all teachers and scientists.
Example #4	7. Program Administration f. Creates collegial atmosphere.	7. Program Administration f. Teachers participate in a group dinner the first night. At the end of the program, they invite scientists to join them for a closing potluck dinner.	7. Program Administration f. Only teachers staying in the dorm participated in the group dinner. Those who commuted did not come. Scientists were invited to the final group lunch. The director of the organization came to make closing remarks and to express his appreciation for the teachers attending.

"Creating a collegial atmosphere" means establishing and supporting an environment in which professional exchange is encouraged and mechanisms are created to make it happen. The description of the program design in Example #1 reflects the intent of this descriptor. Several mechanisms were included in the design (collaborative work, introductory activities, lunches, housing, and meeting places). The report of the program in operation substantiates that these mechanisms were put in place, used, and valued. Here, the program operation reflects both the program design and a quality program.

Examples #2 through #4 tell other stories. In Example #2, the program design reflects a quality program, but operations fall short. What actually happened in the program did not reflect its design. Having a scientist available for consultation does not constitute a collaborative work environment; two scientists attending a single introductory event does not make that event truly collegial; and the group lunches did not occur. Program directors and staff should resolve the difference between design and operations by controlling and improving the operation of the program.

In Example #3, the program design itself does not reflect a quality program. Some staff, however, went "beyond the call of duty" and actually put into place some activities and structures that meant the program in operation surpassed its design. The program in operation more closely reflected a quality program for this descriptor. In this instance, program directors and staff should redesign the program.

In Example #4, both redesign and operations improvements are called for. Differences are found among the three profiles: Neither the program design nor the report of operations reflects a quality program.

Step 3: Develop a Plan to Strengthen the Program's Quality

After comparing the three profiles—descriptor by descriptor and component by component—program directors and staff list the congruencies and differences. *Congruencies* are program strengths, which must be preserved through subsequent changes either in the program design or the operations. Directors and sponsors can feel confident that these aspects of the program will yield the desired outcomes. These automatically strengthen the quality of the program.

Differences are program weaknesses that must be removed to the extent possible. A review of the differences pinpoints areas that may need to be changed. Sometimes program directors and staff know immediately the cause of the difference. For example, on the one hand, if a program had scheduled four field trips and only took two, staff are likely to know why. On the other hand, if recruiting efforts produced only three women participants and one Asian American participant, this result can be baffling. Some situations may require additional information to determine what is causing the difference.

Not all differences require immediate action. Perhaps the program is developmental; one year builds on another. Over a 3-year period, it will incorporate and reflect all the components of a quality program but not necessarily right away.

In any event, this list of differences among the three profiles becomes the focus of a plan to strengthen the effectiveness of the program by making its design and operations more reflective of a quality program. The plan should be formalized as a report. The report, which is shared with sponsors and the community, should contain the following information:

- A summary of congruencies and differences for each component of the program, and an explanation of why the differences occurred
- Recommendations for strengthening each component through changes in the program design, operations, or both
- Issues and concerns about the program's ability to strengthen each component (e.g., resources, expertise, facilities)
- A revised profile of the program design compared with the profile of a quality program

Decisions about whether and how to resolve the differences among the three profiles should be made jointly by program directors, staff, sponsors, and community. If program directors and staff work in isolation, they can make assumptions about what is possible and what is not. One benefit of *profiling program quality* is that because it is such an open and inclusive process, sponsors and communities have heightened commitment to their programs' success and will often attempt the impossible to help strengthen the programs' effectiveness.

We have seen the process work most effectively in situations where the program director meets frequently with the sponsor and the community, involves them in analyzing and interpreting the information, and solicits their suggestions for resolving differences in performance before publishing a formal report or a plan to strengthen the program's effectiveness.

Step 4: Carry Out the Plan for Strengthening Program Quality

Your ultimate goal in using *profiling program quality* is to improve the program. The process is not complete until you see evidence that the program design was revised, program operations were improved, or both, based on the congruencies and differences found when comparing program profiles.

Here are three scenarios that describe common situations that program directors and sponsors might encounter.

Scenario #1

> As a program director; you are reviewing a plan for strengthening program quality for one of your teacher development programs. You notice a descriptor of the *program administration* component that states a quality teacher development program will "design and conduct participant recruitment such that teachers representing and serving underserved populations are reached." The corresponding descriptor in your program design was "recruitment materials encourage school districts to include teachers representing and working with underserved populations." You approved the recruiting materials and know this to be so. It turned out, however, that of the 30 participants, only 2 represented underserved populations and 25 were men. You also notice that teachers came from schools with high multiracial populations. You expected more minority teachers in the program. Nothing in the report explains the difference between your program design and actual operations. Nor is there any plan for removing it in the future.

Obviously, the approach you employed for recruiting teachers representing and serving underserved populations was not effective. Staff may not have pinpointed this difference because they thought the program had made a good faith effort, which, for whatever reason, just did not pay off. Your first step is to discuss this with your staff to solicit their perspectives. Just because there's nothing in the report doesn't mean they don't have some sense of what might be going on. Together, you all may be able to sort this out and know what to do differently next time.

Assume, however, that staff are as perplexed as you are. What can you do? Participants in your program may have some insights. You can ask them why their minority and female colleagues did not apply. Can they assist you in recruiting for next year? Often, a colleague's endorsement can be a major impetus for another teacher enrolling.

To resolve this situation, you need information on what factors are keeping minority and female teachers from applying to your program. Then you can develop strategies to address the key issues and strengthen the quality of your program.

Scenario #2

> You are the program director of a teacher research program in which teachers spend 8 weeks working on a team with scientists and technicians. Before the program started, you and your staff met to compare the profile of your program design with the profile of a quality teacher research program. Then you turned over the task to an external consultant who was responsible for gathering information, developing the profile of the program in operation, comparing the three profiles, and writing the plan to strengthen program quality.
>
> Although you thought you knew exactly what was going on in your program, in reading through the plan you discover that some mentor scientists had very little contact with their teachers, turning them over to either junior scientists or technicians.
>
> This was not the intent of your program. How do you prevent this from happening next year?

Here we actually have two concerns: (a) why some mentor scientists had very little contact with their teachers and (b) why you didn't know about it before now. Your first step is to talk with some of the scientists—both those who spent time with their teachers and those who did not. You can conduct a discussion group, asking the scientists a series of questions about what did and did not work for them. The problem may lie in the selection of mentors, their orientation, or organizational factors beyond your control. As in the scenario above, you cannot resolve a problem until you know what is causing it.

And, you cannot fix a problem that you did not know existed. You and your staff, perhaps along with your external consultant, need to review the feedback mechanisms in your program. Are checkpoints with mentors included? Are ways included for teachers to inform staff easily when some aspect of the program is not functioning properly? What procedures can you install to make sure that you and your staff know what is happening on a regular basis?

Scenario #3

> You are director of an educational outreach group that a year ago agreed to apply *profiling program quality* to all your major programs. Two of your senior program directors attended training. They have

> been overseeing the process, carried out largely by junior staff. Your review of their plans for strengthening program quality shows that although the profiles are complete, the accompanying plans for improvement are very weak. There seems to be little relationship between the profiles and the plans.
>
> What might be the problem, and how do you propose resolving it?

As we delineate later in this chapter ("What Are the Challenges?"), several skills are involved in using *profiling program quality.* It may be that your staff needs to strengthen their skills in analyzing and interpreting qualitative data, determining the nature of a problem and recommending an appropriate corrective action, and conceptualizing and writing plans and reports. Talk with your senior program directors first so that you get their perspectives. You need to know who is writing the reports and who is reviewing them. Where is the breakdown occurring?

Perhaps your entire staff needs some additional training, or maybe just the junior-level staff. Once you have this information, you will know how to intervene.

Step 5: Repeat the Process Until the Program Reflects the Components of Quality Programs

Rarely does a program reflect all the components of quality programs when it is new or the directors and sponsors first use *profiling program quality.* More often, a program evolves into a truly effective one through experience and using the process. All programs have real limitations, however—like resources, expertise, and time—so it is possible that a program can never completely reflect a quality one. What's most important is that program directors, sponsors, and community not lose sight of maximizing the opportunities they have to operate the best possible program.

We recommend that program directors and sponsors use *profiling program quality* at least twice for any program—whether new or existing. If the process has been used wisely, the necessary improvements in program design and operations should occur in this period of time. Once a program reflects the components of quality programs and has stabilized, there is no need to continue the process unless major design and operations changes occur. One way to contain resource costs for the process is to select certain programs each year for examination and then go on to others.

WHAT ISSUES ARE ASSOCIATED WITH USING PROFILING PROGRAM QUALITY TO IMPROVE PROGRAMS?

Three issues should be considered before moving forward with the process. All of these are discussed more fully in the other chapters. We review them briefly here.

1. *Does the program match one of the types we have examined: teacher development, teacher research, student enrichment, or systemic programs?* If so, then the components of quality programs we identified should be adequate with minor or no modification. If not, then program director, sponsor, and community may have to make major modifications or identify the components of a quality program. We mention this in Chapter 2. It is a major investment of time and personnel.

2. *Do all parties have a sufficient commitment to the process?* The effort and resources required for using *profiling program quality* for either designing a new program or strengthening an existing one is extensive. Before moving forward, the program director needs to know whether those affiliated with the program are committed to following the process through to completion.

3. *Are sufficient knowledge and skills in using the process available?* Generally, program directors, staff, as well as evaluators, need some training in using the process, or at least some practice. Are staff trained, or can training be secured?

Once you can answer these three questions affirmatively, you can move ahead.

WHAT ARE THE CHALLENGES?

Profiling program quality is deceptive. The process looks easy, but it is not. Here are some challenges that program directors have encountered in applying the process to their programs:

1. *Profiling program quality requires time and money to use.* For a month-long program, this means setting aside about 15 days for the entire

process (using either an internal or external person or some combination). This covers deciding and planning to use the process, gathering information for and developing the profiles of the program design and the program in operation; comparing the three profiles and pinpointing congruencies and differences; developing the plan to strengthen the program; and refining the program design according to the plan. The process really has no shortcuts (no step you can leave out). As *profiling program quality* becomes a part of the management routine, however, it requires fewer personnel and less other program time to use. The process becomes quicker and easier to use.

2. *Profiling program quality entails a high level of cognitive skill.* Some higher level cognitive skills are involved in carrying out the process:

- Understanding what is meant by congruencies and differences
- Capturing and writing in a concise form what a program intends and what actually happens
- Recognizing the difference between descriptive information and evaluative information
- Determining whether the program design is an authentic representation of a quality program
- Analyzing and interpreting qualitative data
- Determining the nature of a problem and recommending an appropriate corrective action
- Conceptualizing and writing plans and reports

The nature of the tasks dictate that the participants understand *profiling program quality* and be sufficiently experienced and/or trained to carry out the process. We have found that most people, even experienced program directors, need training to apply the process to their programs in a meaningful and cost-effective way.

3. *Deciding to use the process and actually carrying it out are very different.* Program directors wanting to use the process need to take into account the organizational context. Does the culture value and support it, or is it seen as an unnecessary add-on? Many times, staff are more inclined to advocate for their program than to look at it objectively. Are time and money sufficient to support using the process? What are the knowledge and skill levels of the persons carrying it out? Does the program director have the authority to make and carry out a decision to use the process?

Any number of organizational factors can either support or inhibit the use of *profiling program quality* within an organization. These should be identified beforehand and strategies developed for dealing with any factors that are likely to derail or otherwise negatively influence the decision.

Program directors and sponsors find that all these challenges are surmountable and that the value of *profiling program quality* justifies the effort. They are able to answer key questions on program design, operations, and plans for improvements; provide necessary accountability information to sponsors and communities; and have information to make decisions on improving, expanding, or cutting back a program. Finally, knowing the degree to which their programs reflect the components of quality programs enables directors and sponsors to design impact evaluations more accurately to investigate the outcomes of their programs. Moreover, they will be able to relate certain outcomes to specific components of a quality program.

WHAT QUESTIONS ARE FREQUENTLY ASKED ABOUT THIS STAGE OF PROFILING PROGRAM QUALITY?

1. *Is this stage of profiling program quality the same as formative evaluation?* It is very similar. There is, however, one difference. With *profiling program quality,* the standards or benchmarks against which you compare program performance are predetermined: They are the components of a quality program. With formative evaluation, the standards may or may not be clear, although they should be. Often, we see formative evaluation plans that ask questions like, "Is the program operating according to its plan?" This is a good question as far as it goes. But just how good is the plan? *Profiling program quality* lets you know that the plan is a good one—because the program design reflects a quality program based on research and expert experience. In other words, it sets a standard. A quality program is no longer somebody's best guess or personal preference.

2. *What if we do not intend to carry out some component or descriptor of a quality program? Should the profile of the program in operation omit this, leave it blank, or what?* We suggest that you state in the profile of the program in operation that you do not intend to incorporate the component or descriptor at this time. Explain why as well. Do not simply delete the component or descriptor. In this way, the possibility remains open.

3. *May we add descriptors to an existing component?* Yes, if the descriptor you are adding is essential to the success of your program. It should not

be just a descriptor of personal or group preference. You must be sure it is based on research and expert experience. Both of these phenomena are expanding as we learn more about these programs, so it is reasonable to expect new ones to appear. Notice in the profiles of quality programs in Resources A through D that the "other" entry provides a way for you to add descriptors.

4. *How can I be sure my descriptions of components and descriptors for my program are authentic?* In this book, we list five criteria for writing an authentic description. These are that the description is succinct, detailed, purely descriptive, accurate, and credible. If you are not sure about your descriptions, check with others who have more experience. If sponsors and community members can read the descriptions and then accurately recount to you what the program is doing, the descriptions are probably authentic. If not, the descriptions need more work. We have found that descriptions most often lack sufficient detail.

5. *Why should the profiles themselves contain no evaluative or editorial comments?* The descriptions are the actual data from which decisions about how to strengthen a program are made. Judgments are reserved for comparing the profiles of a quality program and the program design with the program in operation. Even then, judgments are confined to congruencies and differences among the three profiles. The description reads like a good newspaper account—"Just the facts, ma'am, just the facts."

6. *Is it possible to cheat on a profile? If so, how and why?* Yes, because the profile is a self-reporting device, it is possible to write descriptions that indicate the program design and program in operation are completely congruent with a quality program when this is not the case. Why someone would do this is a tougher question to answer. Perhaps the community climate is such that the program director is fearful of being honest; perhaps she or he is afraid of losing funding and support. Perhaps someone is "making" the directors use the process, and the directors are being passive–aggressive. If program directors and staff are misrepresenting the program, the climate is not appropriate for using *profiling program quality.* A trusting relationship must exist if directors and staff are to use and gain from the process.

7. *How much actual content or subject matter knowledge does a person need to develop the profile of the program in operation or that of the program design?* Most important is the ability to understand and use the process:

basic knowledge of, and appreciation for, program improvement; ability to gather information and write descriptions; writing skills; ability to analyze and interpret information; and an understanding of program design and operations. These are more important than content knowledge of science and mathematics education, although it helps to be thoroughly familiar with the type of program under examination. If a person has actual content or subject matter knowledge, however, that certainly is a plus. In other words, content knowledge is helpful but not essential.

8. *Should we use profiling program quality every time we conduct a program?* No, that is not necessary. *Profiling program quality* is designed for program improvement. Once your program reflects the components of quality programs and has stabilized, there is no need to continue the process unless you make major changes in the program's design or operations. If you conduct several programs concurrently, you can determine each year which one(s) would benefit most from the process.

Program directors and staff who have been using *profiling program quality* for some time tell us they periodically review program operations to ensure that their programs still reflect the components of a quality program and that operations have not "drifted" over time. We recommend using the process prior to conducting an impact program evaluation to document thoroughly what is going on in the program at that time. Documenting program operations is essential to attributing program outcomes as part of an impact evaluation.

9. *Is it a good idea to require program directors to use profiling program quality?* That is a difficult question to answer. It depends on the situation, especially how the process is introduced and what resources are available to support it. Certainly, it is not appropriate or effective to issue an edict that says henceforth everyone shall use *profiling program quality.* Nor is asking program directors to do something differently and not giving them the resources they need. If, however, the community climate, infrastructures, and resources support the process, then the process has a better chance of contributing to program quality. In terms of level of impact, the process has a moderate impact on most program staff. As a result, an implementation plan should ensure that the process is successfully integrated into the way an organization or community carries out its program efforts.

10. *Have the components of quality programs been identified for more than the four types of programs you worked with?* To some extent. Research and accumulated experience are an ongoing effort, and more knowledge is

uncovered each year. We have begun to identify the components of quality new organizations, as well as those for "learning" organizations. The components have been tested in one setting and show great promise. They are ready for other organizations to try. We also have a draft of the components of quality school-to-work programs and one for the dissemination of health education programs. They need further confirmation and testing. If you are interested, contact the National Center for Improving Science Education (NCISE) in Washington, D.C., at 202-467-0652.

It is possible to adapt the components we have identified to similar programs. This procedure is described in Chapter 2. Looking at the profiles of quality programs in Resources A through D, you will notice that a descriptor "other" is included for each component. You can add your own definition of quality there. But be certain that your definition is based on research and expert experience, not on individual opinion, preference, or hunch.

You can undertake the task of identifying the components of a quality program for other types of programs, but it is a major undertaking and a significant investment of time and money. If you are in a position to do so, go ahead; just follow the process described in Chapter 2.

11. *I can't decide whether to have staff develop our program profiles or to hire an external consultant. What should I do?* This is one question we can't answer. It depends on your resources and desired outcomes. You can also split the task. You can develop the profile of the program design and have the outside consultant develop the profile of the program in operation. It does not have to be an either/or decision.

12. *How much time will the process take?* Allow about 15 days to cover all aspects of the process. If the program in question is especially long or complex—say, as with a systemic program—think in terms of 1 month of personnel time. Fortunately, program directors and staff report that the process is much quicker and easier to use after they are familiar with it.

13. *What in your experience has been the greatest challenge in using profiling program quality? The greatest value?* Helping people compare the program components in operation with those of the program design and quality programs has probably been the most challenging aspect for us. Knowing how to translate the components of a quality program into a program design and recognizing and interpreting congruencies and differences are acquired skills; they do not just come automatically. The greatest value has been seeing program directors and sponsors make program

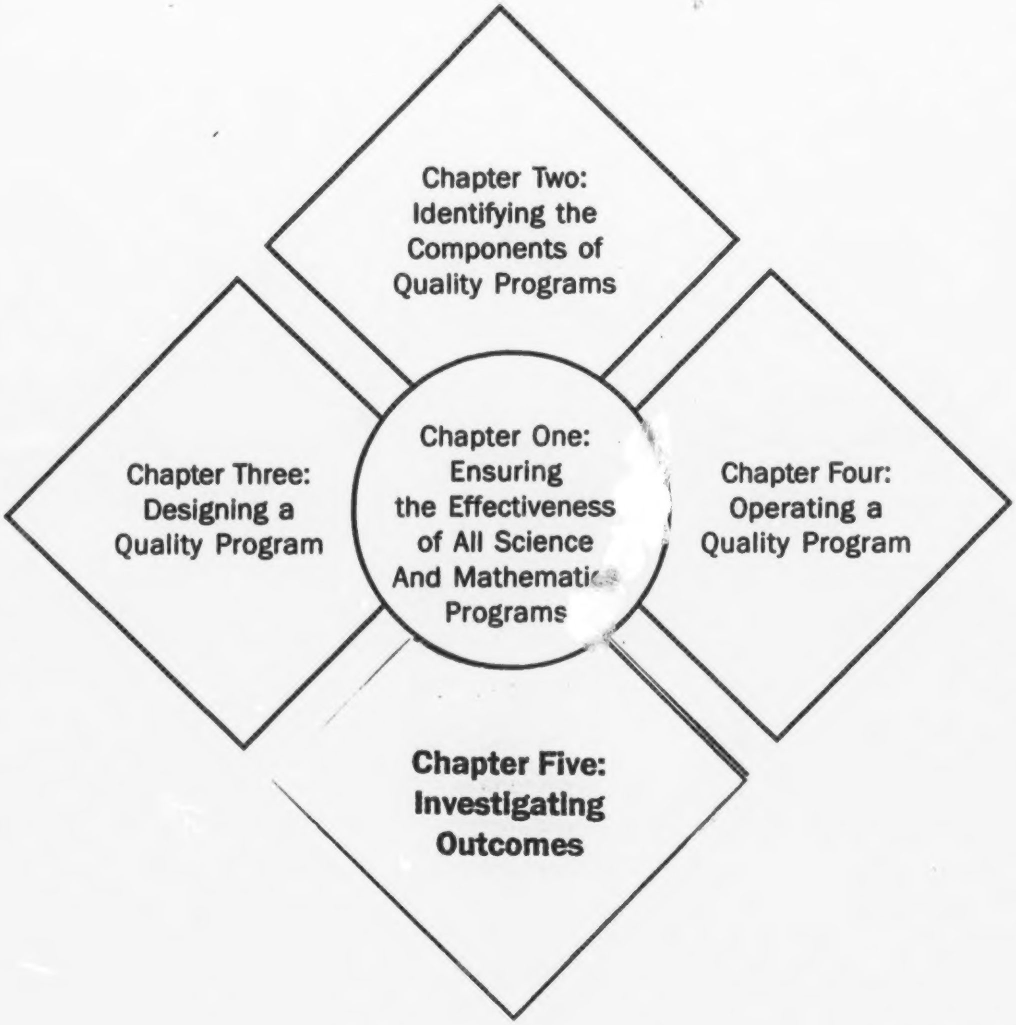
changes, based on the process, that really do strengthen the outcomes of the program.

14. *What tends to be more difficult for people to develop: the profile of the program design or the profile of the program in operation?* Making sure that the descriptions used in the profile of the program design are authentic seems to be the more difficult task. That is closely followed by the difficulties in comparing the program design with the program in operation.

15. *More and more federal and state sponsors are asking for data on program results. Does profiling program quality meet their criteria?* Yes, if you use all three stages of the process. We have not yet touched on the third stage, investigating outcomes. It's the subject of Chapter 5.

If your program requires several years for full implementation to produce the desired student outcomes, the first two stages of the process can serve as interim reports to federal and state sponsors. Research indicates that programs that operate according to the components of quality programs are more likely to achieve significant long-term outcomes.

Policy-level people frequently want summative evaluation data before it is possible to produce such data (see Chapter 5). Part of your job may be to educate individuals who do not understand how long it takes to bring about significant change and how to capture changes in a meaningful way.


Chapter Two:
Identifying the Components of Quality Programs
Chapter Three:
Designing a Quality Program
Chapter One:
Ensuring the Effectiveness of All Science And Mathematics Programs
Chapter Four:
Operating a Quality Program
Chapter Five:
Investigating Outcomes

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5

Investigating Outcomes

Investigating outcomes is the third stage of *profiling program quality.* Program directors, sponsors, and communities begin seriously investigating program outcomes only after their program has operated effectively for some time: when the profiles of the program in operation, the program design, and a quality program are congruent. As a program in operation more completely reflects the profile of a quality program, its outcomes strengthen, deepen, and spread.

This is not to say that directors, sponsors, and communities should ignore program outcomes early in a program's development, but they should not hold a program *accountable* for outcomes until it has evolved into a quality program in operation. When directors, sponsors, and communities seriously investigate outcomes too early in a program's development, they may or may not find much of substance. And when they do, they often cannot link or attribute the outcomes to the program's operations. The third stage of *profiling program quality* addresses these problems.

Investigating outcomes entails the accumulation of information about the effects of the program on its target audiences—teachers, students, schools, and communities. It involves obtaining information from outside the program itself: in classrooms, schools, and community settings. Information-gathering mechanisms often include surveys, interviews, and direct observations, as well as reviews of documentation collected in several contexts.

AUTHORS' NOTE: The superscript numbers are citations that refer to the numbered references listed in Resource E at the back of this book.

Program directors, sponsors, and communities must be careful to hold their programs accountable only for *reasonable* outcomes. A community can expect too much from a support program of the types addressed here. Outcomes that are envisioned to occur far outside the operation of the program itself are more susceptible to influences by the environment. Just as research and expert experience indicate the components of quality programs, they tell us what outcomes are reasonable to expect as well.

If a program is designed and operating according to the components of quality programs, the outcomes should be there. If not, or if they are weaker than expected, the directors, sponsors, and communities look to the combination of components defining the program, and they make choices about which to strengthen even further. They also look to the program's environment to uncover and remove inhibiting influences that are sabotaging program outcomes.

This chapter illustrates the third and final stage of *profiling program quality.* It discusses what we mean by reasonable outcomes and the range of information-gathering mechanisms that most programs have available to examine the effects of the program on teachers, students, schools, and communities. Although program directors, sponsors, and members of the community will be tempted to skip immediately to this chapter, it is important that they first be familiar with the first two stages of the process. These are the subjects of Chapters 3 and 4.

WHAT ARE PROGRAM OUTCOMES?

Program outcomes is a synonymous term for *program results, effects,* and *impact.* In *profiling program quality,* program outcomes are changes in individual and organizational performance. These changes may be in knowledge, understanding, attitudes, or practice for individuals. They may be changes in policy, goals, operations, or structure for organizations expected ultimately to increase student learning and persistence in science and mathematics.

Sometimes a distinction is made among *short-term, intermediate,* and *long-term* outcomes to show that some are present immediately after the operation of a program (e.g., the knowledge and understanding teachers have when completing a teacher development or teacher research program); others require more time and interaction of the program with its environment (e.g., changes in teachers' own instruction, responses of students to new instruction, or structural changes in organizations in response to a systemic program).

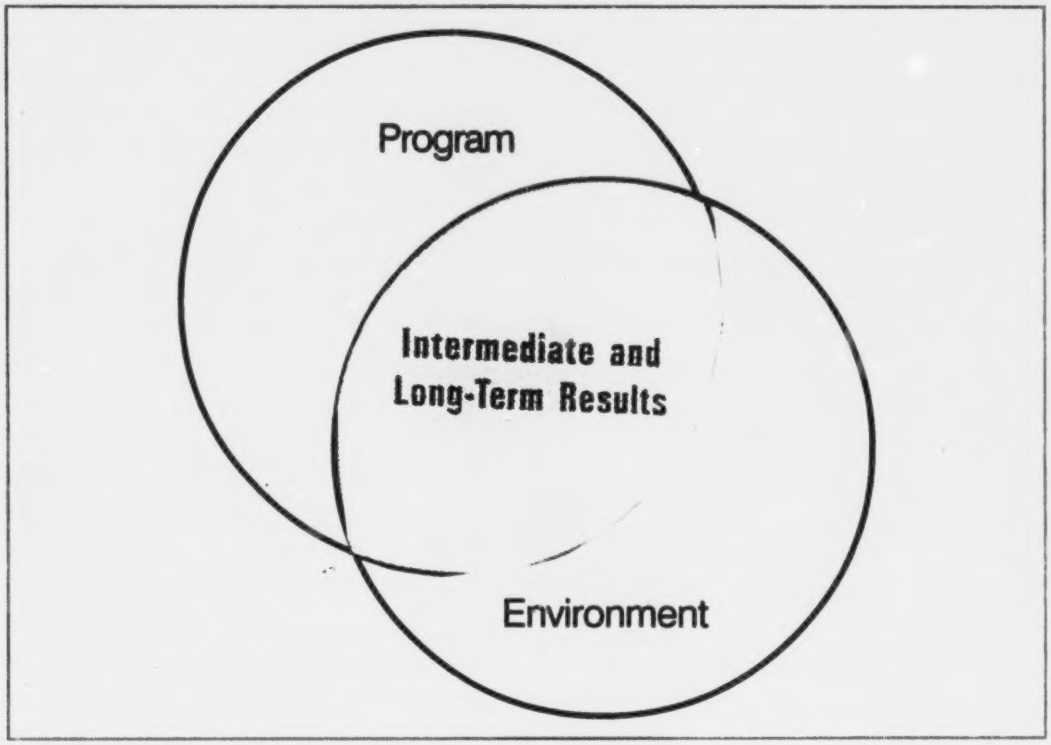

Figure 5.1 Interaction of a Program With its Environment

Intermediate and long-term program outcomes rely on the interaction of the program with its environment (see Figure 5.1). *Environment* is the instructional context, which is most often outside the direct control or boundary of the program itself (e.g., teachers' classrooms, schools, and communities).

Because of this interdependence, program outcomes are subject to environmental influences that can either support or sabotage their strength. The more deeply outcomes depend on friendly environmental influences—that is, they exist farther from the program's operation or boundary—the more likely they are to combine with other environmental influences. It is almost impossible to say that a long-term outcome relates to a single program.

Each type of program addressed here has a *sense* or *logic* that displays how the program should interact with its environment. The logic makes explicit the environmental influences that ensure the program leads to intermediate and long-term outcomes for individuals and organizations. Often, short-term outcomes are visible but intermediate and long-term outcomes are less so. Outcomes of the program "wash out" over time.

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This usually occurs because forces in the program's environment are counterproductive. For example, environmental influences that quite often weaken a teacher development program's intermediate and long-term outcomes include the lack of opportunities for teachers to engage in cooperative unit and lesson planning with school colleagues, inappropriate curriculum and instructional materials and resources, absence of assessment tools that measure in-depth conceptual understanding as opposed to factual recall, and an incoherent instructional and learning philosophy in the school that fails to promote the new instructional strategies that teachers learn in the teacher development program.

Program directors and sponsors should understand their program's logic with respect to its components and environment when designing and operating the program. Figure 5.2 displays the logic of the Bay Area Science and Technology Educational Collaboration (BASTEC), a systemic program operated by several DOE National Laboratories and other organizations with the Oakland Public Schools. The program logic tells directors and sponsors how the program components and environment must interact to support program outcomes. This is a necessary step in investigating intermediate and long-term program outcomes. Another way of saying this is that investigating outcomes means investigating the influences in the program's environment as well.

Profiling program quality attempts to strengthen intermediate and long-term program outcomes in several ways.

- *The process ensures that the program is planned and operates according to the components of quality programs associated with long-term success.* These components make explicit the need for program manager and supervisors to anticipate *systemic connections*—exactly how the program can best interact with the educational environment of classrooms, schools, and communities.
- *The process relies on directors and sponsors coming to a common understanding of the program and its expectations.* Defining expectations necessitates taking into account environmental influences.
- *The process recognizes that all programs can be improved through careful examination and refinement. Profiling program quality* highlights the reality that a program's environment is dynamic—always changing—and that it is simply unrealistic to expect to plan any program only once.

Outcomes themselves are not either good or bad, strong or weak, adequate or inadequate. They assume a positive or negative value when

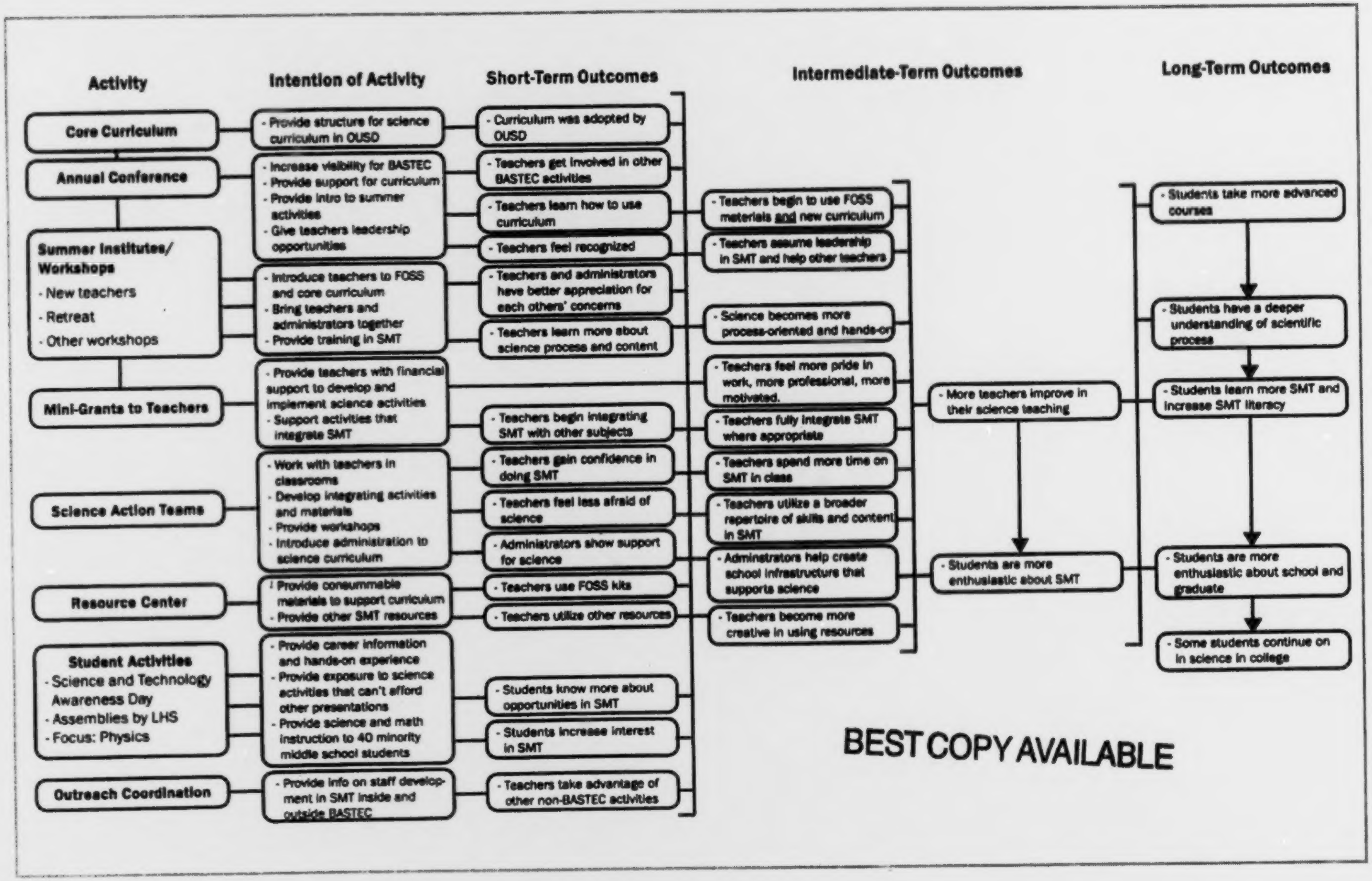
Activity
Intention of Activity
Short-Term Outcomes
Intermediate-Term Outcomes
Long-Term Outcomes
Core Curriculum
- Provide structure for science curriculum in OUSD
- Curriculum was adopted by OUSD
Annual Conference
- Increase visibility for BASTEC
- Provide support for curriculum
- Provide intro to summer activities
- Give teachers leadership opportunities
- Teachers get involved in other BASTEC activities
- Teachers learn how to use curriculum
- Teachers feel recognized
Summer Institutes/ Workshops
- New teachers
- Retreat
- Other workshops
- Introduce teachers to FOSS and core curriculum
- Bring teachers and administrators together
- Provide training in SMT
- Teachers and administrators have better appreciation for each others' concerns
- Teachers learn more about science process and content
Mini-Grants to Teachers
- Provide teachers with financial support to develop and implement science activities
- Support activities that integrate SMT
- Teachers begin integrating SMT with other subjects
Science Action Teams
- Work with teachers in classrooms
- Develop integrating activities and materials
- Provide workshops
- Introduce administration to science curriculum
- Teachers gain confidence in doing SMT
- Teachers feel less afraid of science
- Administrators show support for science
Resource Center
- Provide consummable materials to support curriculum
- Provide other SMT resources
- Teachers use FOSS kits
- Teachers utilize other resources
Student Activities
- Science and Technology Awareness Day
- Assemblies by LHS
- Focus: Physics
- Provide career information and hands-on experience
- Provide exposure to science activities that can't afford other presentations
- Provide science and math instruction to 40 minority middle school students
- Students know more about opportunities in SMT
- Students increase interest in SMT
Outreach Coordination
- Provide info on staff development in SMT inside and outside BASTEC
- Teachers take advantage of other non-BASTEC activities
- Teachers begin to use FOSS materials and new curriculum
- Teachers assume leadership in SMT and help other teachers
- Science becomes more process-oriented and hands-on
- Teachers feel more pride in work, more professional, more motivated.
- Teachers fully integrate SMT where appropriate
- Teachers spend more time on SMT in class
- Teachers utilize a broader repertoire of skills and content in SMT
- Administrators help create school infrastructure that supports science
- Teachers become more creative in using resources
- More teachers improve in their science teaching
- Students are more enthusiastic about SMT
- Students take more advanced courses
- Students have a deeper understanding of scientific process
- Students learn more SMT and increase SMT literacy
- Students are more enthusiastic about school and graduate
- Some students continue on in science in college

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Figure 5.2 Program Logic of the Bay Area Science and Technology Education Collaboration (BASTEC)

compared with a program intent, standard, or expectation. Program expectations, like plans and operations, should be based on research and expert experience.

WHAT ARE REASONABLE PROGRAM OUTCOMES?

Program directors, sponsors, and communities are wise not to expect unreasonable or unrealistic outcomes from a particular program. Research and expert experience play a significant role in identifying program outcomes, just as they define the components of a quality program. This plausible association of outcomes with program operations is constantly changing as we learn more from research and expert experience.

What we are ultimately looking for from any of the four types of programs addressed here—teacher development, teacher research, student enrichment, and systemic programs—are changes in student performance. These changes generally may be increases in students' knowledge and understanding of, persistence in, or more positive attitudes toward, science and mathematics. Each program type addressed here makes a *contribution* to changes in student performance. The current research and expert experience knowledge base indicates, however, that none of them will always result in these changes *when operating alone or as a single influence.* Systemic programs are the most ambitious in intent. Systemic programs seek to control the environmental factors that influence conditions for teaching and learning.

Student achievement is a highly valued type of student outcome. Although the long-term outcome for any mathematics or science improvement program is often student achievement, it is not reasonable to expect that a single teacher development, teacher research, student enrichment, or even a systemic program can bring about and sustain this outcome. Program directors are often held accountable by their sponsors and communities for changes in student achievement for their particular programs. Changes in student achievement may be found when a program operates as a pilot or experimental program with the ability to control the environment tightly, only to dissipate when the program operates at full-scale throughout the community. Program sponsors should understand that increases in student achievement are the outcomes of a portfolio of support programs, including systemic ones, that operate over a long period of time.

Student achievement as a reasonable outcome also awaits the development of valid and reliable assessment tools and methods, which measure in-depth, conceptual understanding of mathematics and science. Until then, types of student performance that research and expert experience tell us are associated with achievement will have to suffice.

This reality does not diminish the importance of individual teacher development, teacher research, student enrichment, or systemic programs. These types of programs have become popular because, when they are planned and operated effectively, they lead to outcomes that, in turn, lead to the types of student performance associated with increased student achievement. They are vehicles for promoting student achievement outcomes.

Reform-Based Program Outcomes

The demand for quality teacher development, teacher research, student enrichment, and systemic programs arises not only from research and expert experience but also from the current reform movements to improve mathematics and science education. These reform movements capture what we know and what we believe about how students learn best and the relationship between teaching and student learning.[5,6,7] They capitalize on the current research and expert experience knowledge base. As such, they provide a framework for program directors and sponsors to use in identifying reasonable outcomes for the types of programs addressed here. Table 5.1 presents a reform-based framework for identifying reasonable program outcomes that program directors and sponsors can use to guide their program planning and operations efforts by using *profiling program quality.* The 12 student and teacher behaviors included in the framework depend significantly on supportive educational and environmental factors at the individual teacher, school, and district levels. They are student and teacher behaviors believed to be linked with long-term increases in student achievement.

Reasonable Outcomes for Quality Teacher Development Programs

Reasonable outcomes for teacher development programs center on the transfer of teachers' knowledge, skills, and attitudes from inside the program to their own classrooms—framework items 6 to 12. Research and expert experience support that it is reasonable to expect that a quality teacher development program will result in teachers adopting and practicing some or all of these behaviors. Specifically, teachers

- Increase their own knowledge and understanding of science and mathematics—as well as processes for studying the subjects[13,14,16]

(Text continued on page 114)

TABLE 5.1 Reform-Based Framework of Reasonable Program Outcomes

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1. **Students do mathematics and science**
   Students actively engage in doing mathematics and science versus learning about the subjects. They are using manipulatives; they are engaged in hands-on activities and are engaging in process skills such as predicting, inferring, comparing, and estimating.

2. **Students engage in inquiry**
   Students use reasoning to answer questions or solve problems to gain conceptual understanding and/or explore cause-effect relationships in understanding principles. Students are given open-ended problems to solve or questions to answer through doing an investigation. They may even be answering their own questions through experiments they have designed, individually or in group projects.

3. **Students collect, manipulate, and use data**
   Students manipulate data collected through their own laboratory investigations and through library and other sources of information. They use this information to provide evidence to support claims in reports and during discussions. Data may be collected and manipulated by using computer-based technologies.

4. **Students communicate**
   Students communicate findings through oral and written reports, discussion, and in journals or logs. Students listen to one another and build on one another's comments during discussions.

5. **Students work collaboratively in groups**
   Students engage in cooperative/collaborative learning through small-group projects, investigations, and other activities. Students interact around the activity and subject matter; they build on one another's understandings; they work together to complete a project or investigation, in some cases, by having different tasks performed by different students.

6. **Teachers use authentic assessment**
   Teachers use forms of assessment consistent with inquiry-based learning (testing for understanding and ability to inquire/solve problems versus short-answer tests that probe for knowledge of facts and definitions).

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7. **Teachers facilitate learning**
   Teachers act as facilitators by asking students open-ended questions, by encouraging students to explain and predict in order to increase their understanding, and by asking probing questions that encourage discussion. Overall, teachers act as consultants to students. Students address one another and often seek help from one another, rather than always looking to the teacher for answers.

8. **Teachers emphasize relations to real life**
   Teachers use examples and applications of the subject matter content in daily life and/or use instructional resources that relate to "real life." Students are able to say how what they are studying relates to what mathematicians and scientists do and give an example from what they are learning.

9. **Teachers integrate science, technology, and mathematics**
   Teachers integrate subject matter areas to exemplify how the different disciplines coexist in actual practice. For example, in science class, a teacher might include statistics concepts when students are learning ways to organize data; in mathematics class, a teacher might include data collection using a science investigation when students are learning statistics concepts. Integration may also include nonscience classes—for example, with regard to language arts for communication tools or with history or government for social issues concerning science.

10. **Teachers offer depth versus breadth**
    Teachers involve students in fewer topics that they cover in-depth in their courses, rather than briefly consider many topics, such as the practice of many teachers who "cover the textbook" during the school year. When involving students in fewer topics, teachers may have students do sustained work (e.g., investigations of projects lasting weeks or months).

11. **Teachers build on prior understandings**
    Teachers relate what students have already learned or what they already know to new understandings. Teachers may do this through an introduction to the day's lesson and/or by engaging students in discussions of their learnings and understandings prior to introducing a new topic.

12. **Teachers use a variety of materials for learning**
    Teachers use a variety of materials and resources, rather than rely solely on the assigned textbook for the course. Some of these resources and materials may be computer based.

- Increase attention to content accuracy in instruction[16]
- Increase their skill in teaching science and mathematics more effectively, such as using a more hands-on/minds-on inquiry approach to instruction, including applications of concepts and their relations to real life, stressing the importance of the subject to society, increasing the use of questioning during instruction, acting as a facilitator of instruction, talking about problems, and discussing alternative solutions[13,15,16]
- Have more confidence in, and enthusiasm about, their ability to teach science and mathematics effectively[13,16]
- Develop curriculum materials for their own use[13,15]
- Introduce new materials and equipment into the curriculum and instruction[13,15,16]
- Use more authentic assessment techniques[16]
- Draw on a wider range of materials and equipment for instruction[15,16]
- Spend more time teaching science and mathematics[13,16]
- Use instructional strategies that engage students more fully in the nature of science and mathematics, such as students carrying out actual investigations, working collaboratively in groups, leading discussions, coaching peers, or investigating the subject as a career[13,15,16]
- Become members of mentor and collegial networks through which ideas and experiences are shared on an ongoing basis and that lessen teachers' feelings of isolation[13,15,16]
- Engage in cooperative unit and lesson planning with colleagues, often using an interdisciplinary approach to curriculum and instruction[15,16]
- Understand new developments and trends in science, mathematics, and instruction[13]
- Participate in subsequent teacher development programs, including those leading to advanced degrees, indicating career satisfaction, a renewed motivation, and a desire for advancement[13,16]
- Become more aware of career opportunities in science and mathematics[16]
- Learn about research settings, organizations, and resources[16]
- Assume leadership positions in their schools, districts, and communities where they coach, mentor, or in some way influence the performance of their colleagues[13]

Whether or not all these outcomes are reasonable for a particular teacher development program depends on the program design—the program goals, how long teachers participate in the program, how intensive their experience is, and how much the program provides for follow-through with teachers in their own classrooms. Whether or not teachers continue to exhibit their knowledge, skills, attitudes, and practice depends on a supportive environment (e.g., short-term outcomes could be positive, but longer-term outcomes could be weak because of environmental influences).

Several environmental factors affect whether or not outcomes for teachers remain in place over a longer period of time--that is, whether short-term outcomes extend into intermediate and long-term outcomes. Factors that often influence the strength of long-term outcomes for teacher development programs are

- The availability of a wide array of instructional materials and equipment, including technologies, that teachers must use to promote a real-life, inquiry-based approach to instruction
- A curriculum whose requirements and expectations are consistent with the instructional practice emphasized in the teacher development program (e.g., emphasizes depth vs. breadth)
- Adequate time for teachers to plan for instruction with colleagues
- Sustained support structures and networks for teachers, such as study groups, case discussions, or action research efforts
- A consistent instructional philosophy throughout the organization (e.g., school) that supports inquiry and that includes administrative procedures, such as class scheduling and teacher assignments
- Consistent expectations for instruction and learning on the part of teachers, administrators, parents, and the entire community
- Assessment tools that measure in-depth student understanding

Teacher development programs can make a significant contribution to expanding the range of activities and performance available to students—framework items 1 to 5. Research and expert experience on the relationships between such activities and student learning is extensive. Program directors and sponsors should be aware, however, that this knowledge base links only, in part, to teacher development programs. Indeed, to this point, investigations of teacher development programs have produced scant evidence on student achievement outcomes that can be linked directly with these programs. Simply too many influential factors outside the typical program boundary affect student achievement, and assessment tools and methodologies have not been developed fully to measure achievement with respect to the reform goals on which the framework is based.

This is not to say that directors and sponsors should not hold high expectations for improved student achievement, only to limit their expectations with respect to a single program. They should be aware of the tentativeness that surrounds program effects and not hold unrealistic expectations nor overpromise outcomes.

Current research efforts indicate that some outcomes for students can be linked with teacher development programs. These outcomes are that students

- Enjoy studying mathematics and science more[13,16]
- Are more able to solve problems and engage in problem-solving activities[13]
- Engage more in actual science and mathematics, including working collaboratively in groups[16]
- Increase their conceptual understanding of mathematics and science[13]
- Increase their own independent research skills[15]
- Read, write, and communicate their understanding of the subject more[15,16]

Reasonable Outcomes for Quality Teacher Research Programs

Outcomes for teacher research programs overlap somewhat with those for teacher development programs, but the two types of programs are very different. Although both target teachers, the key aspect of a teacher research program is giving teachers direct experience with science, mathematics, engineering, and technology processes and cutting-edge knowledge of "real world" science and mathematics. Teacher development programs often focus on implementing new content and pedagogy in the teacher's classroom, whereas teacher research programs may include only minimal transfer to classroom activities. Whereas teachers participating in teacher development program often work collaboratively in groups, teachers in teacher research programs generally work alone in collaboration with other research personnel. Teacher research programs may focus on research experiences across a variety of subject and skill areas; teacher development programs focus on a particular subject (e.g., open-ended analysis in mathematics, particle physics in science).

Expectations of changes in classroom practice are not as strong for teacher research programs as for teacher development programs: The framework is not as appropriate for this type of program. Teacher research programs are an example of programs making contributions to changes in student and teacher performance by building the knowledge, confidence, and excitement of teachers. This is an important contribution, as our research and expert experience indicate strongly that teachers possessing such knowledge and attitudes are likely to adopt and seek out the practices associated with improved student performance—framework items 6 to 12. Program directors and sponsors can expect teacher research programs to

- Increase teachers' own knowledge and understanding of cutting-edge science and mathematics, as well as processes for research in the fields[13,14,16]
- Renew and revitalize teachers as professionals with membership in a community of scientists or mathematicians (teachers see themselves as scientists or mathematicians)[13,16]
- Increase teachers' interest and confidence in teaching mathematics and science[13,14,15,16]
- Encourage teachers to engage students in authentic science and mathematics investigations[16]
- Increase teachers' knowledge and understanding of career opportunities in science, mathematics, and related technical fields[16]
- Increase teachers' knowledge of equipment use and techniques[16]
- Increase teachers' knowledge and use of research facilities, organizations, and resources[16]
- Enable teachers to become more active in mathematics and science education communities[16]
- Provide entry for teachers into professional networks of practicing mathematicians, scientists, engineers, and teachers[16]
- Contribute to increased participation of underrepresented and minority teachers and of teachers who serve underrepresented populations in science, mathematics, and engineering research[16]
- Motivate teachers to seek more research opportunities, including those leading to advanced degrees[16]

Environmental factors do not play as strong a role in long-term outcomes because teacher research program outcomes are not tied directly to classroom practice and student performance. Whether or not short-term outcomes stabilize through longer periods of time is related to

- Teachers' access to additional research opportunities and communities of scientists and mathematicians
- The personal recognition and reinforcement that teachers receive from their colleagues, sponsors, and communities
- Opportunities teachers have to apply their new knowledge and understanding of cutting-edge science, mathematics, and research processes

Likewise, the linkage between outcomes for teachers participating in teacher research programs and outcomes for their students is weak. Research has shown that students working with these teachers often have more opportunities to engage in realistic investigations using a wider range of materials and equipment, perceive the excitement and confidence with which their teachers approach instruction, and consequently enjoy studying the subjects more (framework items 1-4).

Reasonable Outcomes for Quality Student Enrichment Programs

In student enrichment programs, students are the target audience. Reasonable outcomes focus on changes in students' knowledge and understanding of, and attitudes toward, science and mathematics. Research and expert experience show that quality student enrichment programs can result in students

- Enjoying studying science and mathematics more[1]
- Expressing an interest in or pursuing science and mathematics as careers[1]
- Increasing their confidence in their ability to do well when studying mathematics and science (specifically), as well as when studying other subjects (generally)[1]
- Increasing their understanding of the nature of mathematics and science and the relevance of these subjects to everyday life[1]
- Seeking out and appreciating opportunities for active, inquiry-based learning[1]
- Seeking out opportunities to work with others, rather than alone, and increased group work skills[1]

- Increasing their investigative skills, such as listening, observing, taking notes, collecting, analyzing, and interpreting data; formulating tentative conclusions; and reading, writing, and speaking about science and mathematics[1]
- Seeking opportunities to participate in more enrichment activities in their community[1]
- Spending more leisure time engaged in mathematics- and science-related activities, such as community or school clubs and organizations, "tinkering with" or building things at home, caring for plants and animals, visiting science centers, or talking with adults engaged in science and mathematics careers[1]

Most of these outcomes are outside the reform-based framework in Table 5.1. As with teacher research programs, however, they are linked with framework items 1 to 5 *if* the school and community environments are supportive. The extent to which these outcomes have a long-term or lasting effect appears related to several environmental factors, not the least of which is whether the student really wanted to participate in the enrichment program. Outcomes appear more permanent if

- Mathematics and science instruction "back home in school" reinforces active, inquiry-based learning
- Students belong to a peer group that shares their interest in, and excitement about, mathematics and science
- The school and the family recognize and reinforce the student's participation in the enrichment activity and encourage future activities, such as taking more mathematics and science courses or pursing a career in the fields
- Additional enrichment opportunities are available in the community

Reasonable Outcomes for Quality Systemic Programs

Systemic programs focus almost entirely on enhancing, improving, or in some way strengthening the environment that supports effective teaching and student learning. The target for these programs is a *system,* wherein the system is thought of as a state, region, district, or school. Systemic programs look to leverage resources, individual programs and services, expertise, policy, or organizational structures. In so doing, they seek to improve teaching and learning.

Systemic programs are a relatively new concept in education. Research and expert experience are limited because, as yet, descriptions of reasonable outcomes are few. Those that do exist are procedural in nature. Program directors and sponsors should know that when they undertake a systemic program, they are breaking new ground. To date, what we know about systemic programs leads us to expect that they

- Make the *systemic connections* for individual teacher development and teacher research programs by managing and regulating the environmental factors supporting these programs' intermediate and long-term outcomes (e.g., restructuring class scheduling to allow teachers the opportunity to plan cooperatively with colleagues, encouraging the purchase and use of instructional materials and resources that support inquiry-based instruction, providing sustained follow-through for individual programs);[2] to this extent, reasonable outcomes for systemic programs encompass those of quality teacher development, teacher research, and student enrichment programs[8]
- Impart a shared vision of effective teaching and student learning, as well as a shared understanding of the required educational and environmental supports by all portions of the community (community includes teachers, administrators [central office and building], parents, business/industry, and postsecondary institutions)[9,10,11]
- Change individual functions of the system (e.g., curriculum, instruction, assessment, professional development, materials and resources, organizational structure, governance, resource allocation)[4]
- Increase the substantive coherence and coordination among individual components of the system and across systems (e.g., curriculum and assessment, curriculum frameworks, national and state standards, state and local policies)[4]
- Establish an alliance of organizations that sustains the systemic initiative over time, especially after special funding expires[11]
- Establish a permanent change and renewal infrastructure[4,11]
- Increase system equity through the application of high standards and expectations for all students, expansion of both access and skill attainment for traditionally underrepresented groups, and implementation of special strategies for reaching groups of students for whom there is a performance gap[8,11]
- Improve the transition of students from school to work

The major larger environmental factor that affects whether or not quality systemic programs can achieve reasonable outcomes is *time*. Such an enterprise appears to require from 7 to 10 years to realize its expectations. During this time, goals and priorities for the program must remain constant.

HOW DO WE DECIDE WHICH OUTCOMES TO INVESTIGATE?

Planning for outcomes is part of planning the program itself. Outcomes and expectations appear in the program design as goals and objectives. How, then, are program directors and sponsors to choose key outcomes—ones they will investigate?

Resources alone often dictate that all reasonable outcomes cannot be investigated. Most often, a program is designed in response to a few key expectations. The task of program directors and sponsors is to choose a *few* outcomes that not only are reasonable but meet other criteria as well. These criteria are that the outcomes

- Are *valued* by the community
- Can be investigated and explained *credibly*
- Are *linked* logically with the operation of the program

Value

The community always has particular expectations for its programs (e.g., improve student interest in mathematics and science, better prepare students for postsecondary study and professional success, expand the capabilities and confidence of its teachers, respond to national and state standards for mathematics and science education). These expectations indicate situations or conditions of value to the community.

Considered discussions among all members of the community will certainly uncover these values and their related program expectations. Program directors and sponsors should seek to investigate outcomes that reply to these expectations. When the community's values and program expectations are not reasonable, directors and sponsors have their work cut out for them. The more the community knows and understands what expectations are reasonable for teacher development, teacher research, student enrichment, and systemic programs and how these complement longer term expectations, the easier this consensus building will be.

Credibility

Program directors and sponsors have to take a long, hard look at their ability to investigate an outcome in a credible manner. What will be the cost

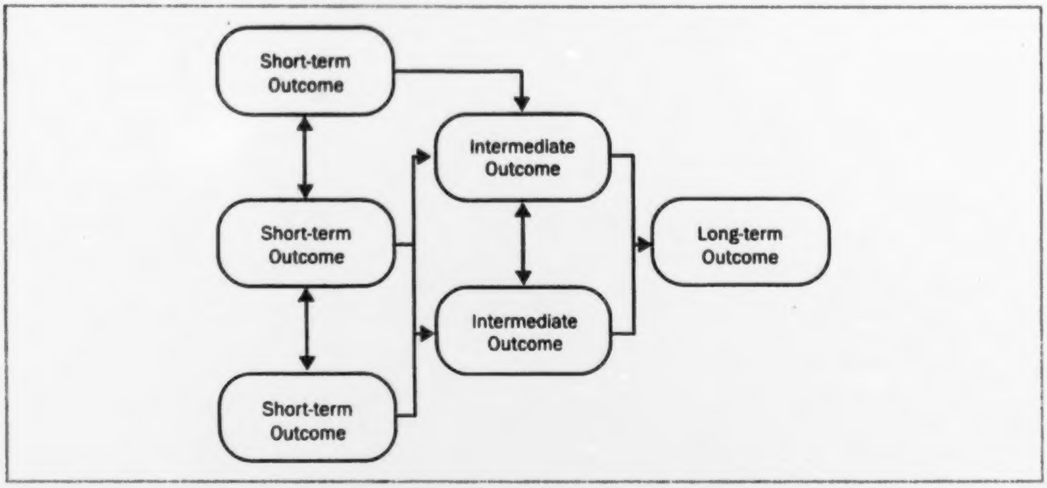

Figure 5.3 Program Outcome Logic

of investigation? Do the tools (e.g., instruments, methods) exist? Is specialized expertise for information analysis available? Will the information gathered through the investigation convince the community that the outcome is real and important? Should external consultants or third parties be engaged to increase the objectivity of the investigation?

Link to Program Operations

For outcomes to be credible to the community, program directors and sponsors must ensure that the outcomes can be *ascribed* or *attributed* to the program (Are the outcomes a consequence of the program?). This is particularly difficult when dealing with intermediate and long-term outcomes because these are often the product of a program's interaction with its environment.

Program directors and sponsors use the concept of a program's *sense* or *logic* to identify outcomes they believe to be most strongly linked with a program's operation. This logic displays directors' and sponsors' assumptions about the relationship among short-term, intermediate, and long-term outcomes. This is not a one-to-one or linear relationship. Short-term outcomes combine to produce intermediate-term outcomes. Intermediate outcomes combine as well to produce long-term outcomes (see Figure 5.3). And, of course, the environment plays a significant role in each logical step.

Figure 5.4 shows the program logic for a student enrichment program—specifically, Science Quest, operated by the DOE National Laboratory at

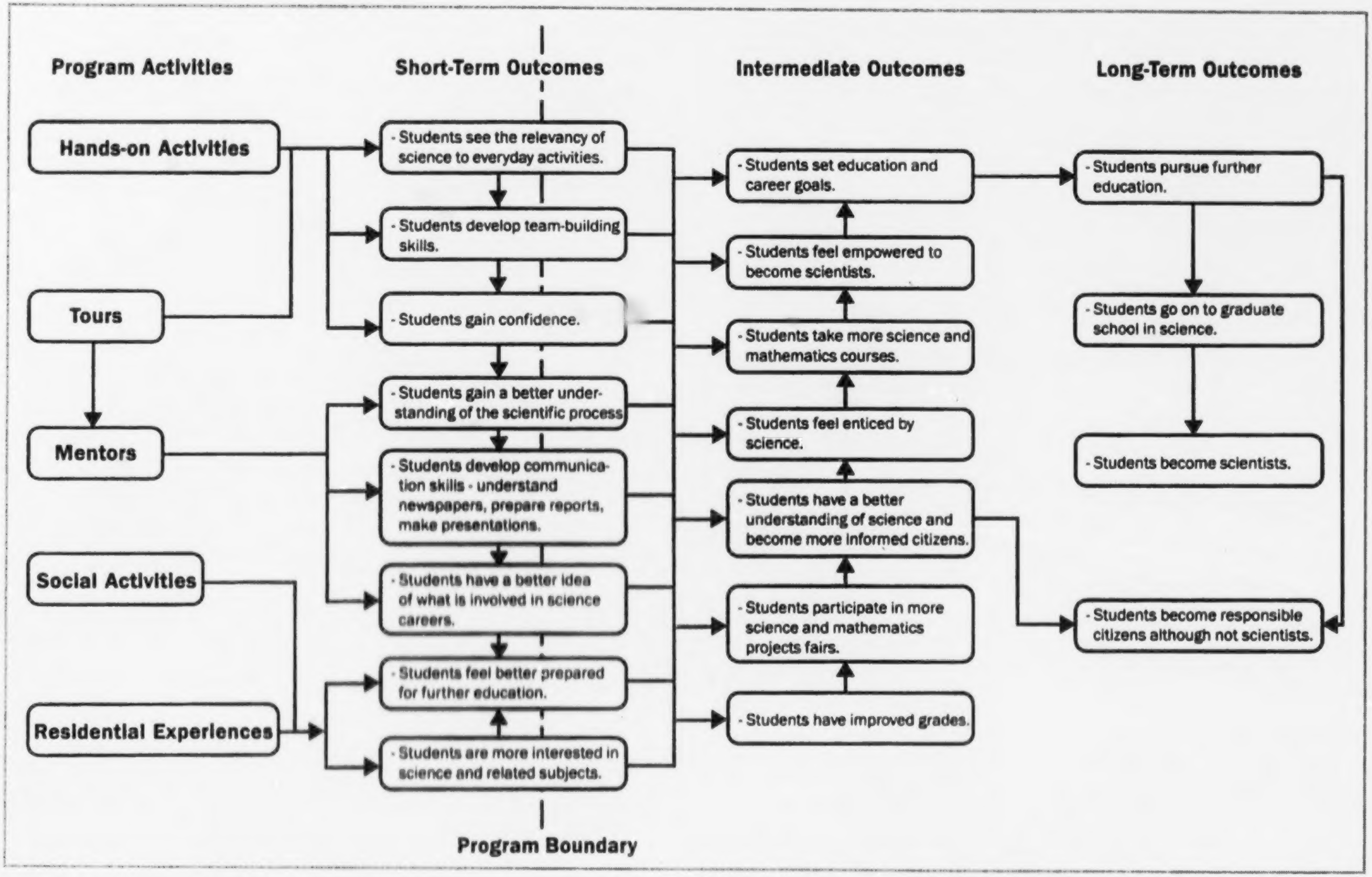
Program Activities
Short-Term Outcomes
Intermediate Outcomes
Long-Term Outcomes
Hands-on Activities
Tours
Mentors
Social Activities
Residential Experiences
- Students see the relevancy of science to everyday activities.
- Students develop team-building skills.
- Students gain confidence.
- Students gain a better understanding of the scientific process
- Students develop communication skills - understand newspapers, prepare reports, make presentations.
- Students have a better idea of what is involved in science careers.
- Students feel better prepared for further education.
- Students are more interested in science and related subjects.
- Students set education and career goals.
- Students feel empowered to become scientists.
- Students take more science and mathematics courses.
- Students feel enticed by science.
- Students have a better understanding of science and become more informed citizens.
- Students participate in more science and mathematics projects fairs.
- Students have improved grades.
- Students pursue further education.
- Students go on to graduate school in science.
- Students become scientists.
- Students become responsible citizens although not scientists.
Program Boundary

Figure 5.4 Program Logic of the Science Quest Program

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Oak Ridge, Tennessee. The short-term outcomes, which exist both inside and outside the program boundary, are that students

- See the relevance of science to everyday activities
- Develop team-building skills
- Gain confidence
- Gain a better understanding of the scientific process
- Develop communication skills—understand newspapers, prepare reports, make presentations
- Have a better idea of what is involved in science careers
- Feel better prepared for further education
- Are more interested in science and related subjects

Short-term outcomes combine in the students' own environment to produce several intermediate-term outcomes—namely, that students

- Set education and career goals
- Feel empowered to become scientists
- Take more science and mathematics courses
- Feel enticed by science
- Have a better understanding of science and become more informed citizens
- Participate in more science and mathematics projects/fairs
- Have improved grades

Intermediate outcomes in this case introduce another participant—parents. The Oak Ridge program logic includes as an intermediate outcome that *parents support students' career goals, science interest, and education,* which, in turn, contributes to *students participating in more science and mathematics projects/fairs and having improved grades.* Program directors and sponsors include an intermediate-term outcome that is contrary to their program expectations—namely, that *students get turned off from science.* Thinking through a program's short-, intermediate-, and long-term outcomes includes *all* the possibilities, not just the positive ones.

Long-term outcomes are that students

- Pursue further education
- Go on to graduate school in science

- Become scientists
- Become responsible citizens, although not scientists

HOW DO WE COLLECT INFORMATION ABOUT OUTCOMES?

How information about outcomes is collected speaks directly to the *credibility* of outcomes. Outcomes have to be investigated by using personnel, tools, and methods that are defensible to, and believable by, the community. The research and program evaluation knowledge base on which program directors and sponsors can rely when choosing how to collect information about program outcomes is sufficient.[12] The possible exception is with systemic programs. This type of program is so new and unexplored that sufficient tools and methods are not widely available.

Program directors and sponsors have several options for ways to collect information about teacher development, teacher research, student enrichment, and systemic program outcomes. These include reviewing records, testing, surveying, interviewing, conducting focus or discussion groups, observing, keeping logs and journals, and reviewing performance.

Reviewing Records

Documents related to the program tell the "public story." Documents also, in the case of systemic programs particularly, indicate the policy commitments that organizations make to changes and improvements. Records are often overlooked as a source of information about outcomes, yet this source can often tell investigators a great deal (e.g., did students take advanced mathematics and science courses, did they achieve acceptable grades and enter postsecondary education?). Records can be reviewed systematically and important items recorded for analysis.

Testing

In some cases, existing tests measure program expectations. The problem with tests is that they often measure something different from what the program sees as its outcomes. Tests are best used to measure long-term outcomes after sufficient time has elapsed for changes to appear. If the intent of the teacher development program was to help teachers introduce a specific curriculum or hands-on/minds-on activities, relevant tests are appropriate to assess whether students have learned the intended concepts and skills.

Surveying

Surveys provide quantitative data for a large number of people at a relatively low cost and can be used to provide statistically representative data if sampling is appropriate. Substantial work is needed to construct survey items that participants interpret consistently and that provide useful information about outcomes. For lengthy surveys that require a lot of time to complete, obtaining high response rates can be a problem. In addition, surveys may be prone to many biases, such as participants making socially desirable responses that may or may not reflect what they actually think or are able to do in the classroom. Survey costs escalate when open-ended questions are included. The value of the information obtained by using open-ended responses should be weighed against the higher analysis costs.

Interviewing

Interviews are more time-consuming than surveys for investigators; however, they can provide an in-depth picture of participants' understandings, as well as firsthand opinions about outcomes. Interviews often are used to clarify and supplement information obtained through other means: surveys, observations, logs, and journals. Interviews are also a good method to use to uncover unintended or unplanned outcomes. Conducting open or semi-open format interviews requires considerable investigator skill and experience.

Conducting Focus or Discussion Groups

Focus and discussion groups are similar. *Focus groups* involve people with different perspectives on an issue, or in this case, on the outcomes of the program (e.g., students, teachers, parents, administrators, businesspeople). *Discussion groups* tend to involve people with the same perspective (e.g., teachers). Focus groups are also used in planning a program or in figuring out how to address an issue (e.g., designing a survey, identifying key outcomes). Information from both types of groups provides insights that supplement, complement, and clarify information collected through more quantitative means, such as surveys. Unexpected outcomes or interpretations are likely to emerge. Some problems may arise in using these methods: Group dynamics can discourage minority opinions. The investigator must encourage all opinions while getting participants to focus on the questions.

Acting as the group moderator, therefore, takes some degree of skill and experience.

Observing

Observing participants in their own environments can be a powerful way of collecting information on outcomes. When observing, the investigator is not relying on self-reported responses and opinions, but on important behavioral information from the perspective of an outside observer. Observational information is more objective in this sense. The difficulty with observing program outcomes is that information collected over a short period of time—1 or 2 days—is unlikely to provide an adequate picture of the overall practice or routine. In addition, an observer's presence in the classroom, for example, can affect the teacher's and students' performance. Observation protocols require some expertise and training to use. When information is gathered by more than one investigator, care must be taken to ensure that all investigators use the same assumptions and procedures. Otherwise, each observer may inadvertently introduce his or her own perceptions and biases.

Keeping Logs or Journals

Keeping logs or journals entails participants in the program or people thought to benefit from the program maintaining written logs or journals. Directions may be quite specific or more open-ended. Logs and journals are experimental; experience about what may be expected from this method is limited. Because participants control the writing themselves, however, the writing is thought to be a more accurate reflection of the respondents' thoughts and behaviors than a survey or interview that provides prompts and asks respondents to recall past behaviors and practices. Logs and journals require schemes or rubrics for careful analysis, another technique that calls for some experience and training.

Reviewing Performance

Performance methods are designed to measure in-depth understanding, problem solving, or application. Instead of asking people what they know or understand, investigators request them to carry out a prescribed task and assess how they perform. As with logs and journals, schemes or analysis rubrics have to be developed if performance is to be analyzed and compared for several people. Performance methods are costly and require skilled investigators.

The Investigation Plan

Program directors and sponsors must plan to investigate outcomes just as they plan for their programs. Investigation plans take numerous forms; however, credible plans meet some generally accepted criteria. For example:

- *Several methods are used in collecting information about outcomes, with a collection schedule that allows information gathered through one method to inform subsequent collection activities.*
- *Each method aims to investigate more than one outcome.*
- *Methods are matched to resources.* If cost is a factor, a few of the most informative methods are chosen, rather than a larger number of methods used ineffectively.
- *Methods are matched to investigator skill and expertise.* Resources will always need to be set aside for this purpose.

WHO IS INVOLVED IN INVESTIGATING OUTCOMES?

Program directors, staffs, sponsors, and the communities all have roles and responsibilities in investigating program outcomes.

Program Expectations and Key Outcomes

Reasonable, credible, and valuable program expectations must arise from discussions by, and agreement of, all parties; differences among the parties must be negotiated and resolved. A community's role and value must not be ignored or minimized; their involvement ensures their demand for the program. Directors and sponsors must make every effort to guarantee that the voices of potential program participants are heard in this discussion.

Logical Connection of Short-, Intermediate, and Long-Term Outcomes

Program directors and sponsors work together to define the logic or sense of the program. Usually, directors and staff "do the footwork." But the sponsors should sign off on the program logic so that both parties hold the same expectations for how the program will interact with its environment. This is especially important when sponsors have more influence in shaping the environment than the program directors and staff (e.g., sponsors can influence the purchase of instructional materials, changes in teacher planning time, or the program's duration). External consultants, third parties, or informed outsiders can help clarify and articulate logical program outcomes.

Planning the Investigation

Planning the investigation is usually assigned to the program director and staff. Outside expertise is often sought at this point, not only for planning but also for collecting and analyzing information about outcomes. Involvement of external personnel is often thought to lend credibility to the investigation. The sponsors join the directors and staff in certifying that the plan is appropriate and feasible, including the allocation of funds to support its implementation.

Collecting, Analyzing, and Reporting Information About Outcomes

Program directors, staff, and outside experts collect and analyze information about outcomes and then format the information for presentation to program sponsors.

Using Information About Outcomes

Using the information to refine the program's expectations, plans, and operations is the joint responsibility of program directors, staff, and sponsors. Sponsors must participate in this process. Although time-consuming, the alternative is that sponsors themselves are surprised when their programs' outcomes differ from expectations. When programs' outcomes depend significantly on their interaction with the environment, sponsors have to be involved. They are more often in a position to influence the environmental factors that support intermediate and long-term outcomes.

Using information about outcomes to report to the community is the lead responsibility of program sponsors. They figure prominently in distinguishing certain from tentative outcomes and positioning programs for community acceptance.

HOW DO WE USE INFORMATION ABOUT OUTCOMES?

Collecting information about outcomes (at least short-term ones) begins with the initial operation of the program. When programs are new and untested themselves, however, directors and sponsors must be cautious about how they use information about outcomes. It is unfair to use this information to judge whether or not a program is successful or to hold directors accountable for outcomes. Programs need time to mature or stabilize. The primary benefit of *profiling program quality* is that it allows programs to improve over time on the basis of their profiles compared with components of quality programs.

When a Program Is New

When a program is new, directors and sponsors use information about outcomes to test the appropriateness and feasibility of the investigation plan. Are all the key outcomes being thoroughly investigated, including those that were not expected? Are the investigation tools and methods yielding valuable and credible information? Are operational snags being hit in carrying out the plan? Can some tools and methods be discarded to conserve resources? Can the investigators carry out the plan, or are more training and assistance required? One outcome of this pilot inquiry is likely to be refinements to the investigation plan itself.

The crucial use of information about outcomes when a program is new or experimental is refining the program's expectations, design, and operations. Program directors and sponsors think the key outcomes are reasonable, but are they? Does investigation uncover flaws in the program's logic? It is dangerous to continue to hold an expectation for program outcomes that investigation does not substantiate. It is wise to uncover gaps or misconceptions in program designs and operations before more time and money are expended and when midcourse corrections can still be made. The emphasis here is on investigating short-term and intermediate outcomes.

When key outcomes are not substantiated through initial investigations, the first place the director and sponsor look is to the program's operation. Is the program's operation reflecting all components of quality programs? Can directors and sponsors strengthen operations? If not, then can they alter expectations and explain the limitations to the community?

As a Program Develops

If the program is operating effectively and short-term outcomes are evident, initial investigation can still find that the program's intermediate-term outcomes are "iffy." Then directors and sponsors must decide whether the environmental influences can be shaped to support the program's longer term outcomes. For example:

- *Teachers try a hands-on/minds-on inquiry approach to instruction immediately after participating in a teacher development program but abandon the approach after 3 months.*

The short-term outcome is present, but the intermediate outcome—sustained use of inquiry-based instruction—is not. There are several environmental reasons why this might occur. Early investigation could find a conflict between carrying out an inquiry approach to instruction and available instructional materials or time for planning and experimentation to implement the approach. Peer and supervisory reinforcement and support practices at the school level may counteract teachers' motivation and energies. The teachers may have been reassigned and are no longer teaching mathematics or science.

Directors and sponsors face the task of reconfiguring the classroom and school environment to support the teacher development program outcomes. This may mean altering teachers' schedules and assignments, interacting with the principal and staff on preferred approaches to mathematics and science instruction, or allocating resources to purchase the necessary instructional materials. These actions may change the design of the teacher development program: This is what the *systemic connections* component of quality programs implies.

These are examples of frequently encountered disconnections between short-term and intermediate outcomes for the other types of programs we examined:

- *A teacher attends a teacher research program but indicates no interest in pursuing similar opportunities offered in the community.*

This is not a desirable outcome. One long-term outcome of teacher research programs is teachers' pursuit of additional adult learning experiences and the desire to continue learning about mathematics and science.

Program directors and sponsors have to take a hard look at the teacher research program design and operation before more resources are allocated to the program. If the program is operating effectively, then questions must be posed about recruitment practices or the teacher's school and community environment. Are similar opportunities available in the community, or can they be created? Are the teacher's colleagues, sponsors, and community aware and supportive of his or her accomplishments? Is there a latent fear that he or she will now leave teaching?

- *Students participating in a student enrichment program fail to register for advanced or honors courses in English, history, or mathematics for which they are qualified.*

If the program was effective, then environmental influences could have intervened to "wash out" the intermediate outcome. For example, advanced or honors courses could be seen as only for "nerds" in the school, or the courses themselves could be unexciting, especially when contrasted with the quality of the enrichment experience. If this outcome was planned as a consequence of a single enrichment experience, then it probably was unreasonable.

- *Students have had an inquiry-based set of high school science courses concentrating on deep understanding of a few key concepts, but the state science assessment stresses knowledge of a broad range of science facts.*

Students may perform poorly on the state science assessment, which, in turn, could reflect negatively on the program outcomes. In fact, the poor performance can be accounted for by the use of an inappropriate measurement of program outcome—namely, the state science assessment.

When a Program Is Stable or Fully Developed

Now, program directors and sponsors are collecting information about outcomes to document the effectiveness of the program for the community. The emphasis is on intermediate and long-term outcomes. The community wants to know how they are benefiting from the teacher development, teacher research, student enrichment, or systemic program. How has individual (student and teacher) or organizational performance or both changed as a consequence of the program? What are the future consequences to the community of (a) continuing, (b) expanding, or (c) ceasing or curtailing the program's operations? Do the program benefits justify the costs?

Program directors and sponsors will find that the community is now acutely interested in the credibility of their investigations into outcomes. This is the point at which *accountability* becomes an issue.

Profiling program quality was developed to ensure that program directors and sponsors would be successful at this point. Directors and sponsors must take one more look at the program, however, when choosing intermediate and long-term outcomes for accountability—outcomes for which they will be answerable to the community. In all likelihood, some program outcomes are stronger and more certain than others. Directors and sponsors must distinguish for the community the outcomes that are certain from those that are still tentative and that will depend not only on the program itself but also on the continued presence of supportive environmental factors.

WHAT QUESTIONS ARE FREQUENTLY ASKED ABOUT INVESTIGATING OUTCOMES?

1. *At what point is it appropriate to hold a program accountable for certain outcomes?* This depends of what type of outcome you are talking about. Programs can be held accountable for short-term outcomes—ones that should be realized through individual program activities—once you are sure the relevant activities are operating according to (a) design and (b) the components of a quality program. For example, are workshop or institute activities inquiry-based? Do participants actually increase their knowledge and understanding of inquiry-based science? Even new programs can be accountable for short-term outcomes.

Accountability for achieving intermediate and long-term outcomes requires that a program be fully developed and stable and reflect the components of a quality program. Sufficient time also has to have elapsed for the outcomes to occur. This could take some time—even years. For example, a long-term outcome of a student enrichment program might be that middle school students pursue a vigorous science and mathematics academic program through high school and go on to major in science and mathematics disciplines in college. Investigating this outcome means waiting and watching student progress over as many as 6 years.

Even with sufficient time to investigate intermediate and long-term outcomes, accountability is tricky. Program directors have to be careful assuming responsibility for intermediate and long-term outcomes when they have little or no control over the environmental factors that influence success. The environment can change. A good program investigation plan tracks these factors and takes them into account when reporting program responsibility for intermediate and long-term outcomes.

2. *How do I know whether a desired outcome is a reasonable one?* Reasonableness has three tests. First, do program directors, staff, and sponsors all agree that the program's design and operation logically lead to the outcome? Second, do examples in the knowledge base or experience of expert practitioners support the outcome? Have other programs achieved the outcome with similar designs and operations? Third, are the environmental factors supporting the outcome in place, or can they be controlled to support the outcome?

When designing a program, knowing whether a particular outcome is reasonable can be difficult. After all, program directors and sponsors are constantly looking for more efficient and effective ways to improve science and mathematics education, as well as more powerful indicators of student learning. Hence, program directors often are held responsible for program outcomes that may or may not be reasonable. *Profiling program quality* enables program directors and sponsors to investigate *explicitly* and to determine the reasonableness of each potential outcome early in the program's life cycle and to refine their expectations before the notion of accountability sets in.

3. *My administrator wants to see results of professional development almost the next day. How can I explain the time required for teacher and student change without sounding defensive?* If you are using *profiling program quality* as a management process, your administrator should already understand and agree with the logical sequencing of short-, intermediate, and long-term outcomes because you involved him or her in the program design process. Show him or her the reform-based framework of reasonable program outcomes included as Table 5.1 in this chapter as a rationale for why teacher change takes time and must occur before meaningful student change.

If you are new to the process and starting with an existing professional development program, you have an educational task ahead of you. This book should help. Suggest that your administrator scan Chapters 1 and 5 to understand how outcomes are logically sequenced and build on one another as cumulative events and activities occur. If this is still not convincing, suggest to your administrator that he or she consult the knowledge base or speak with colleagues responsible for similar programs. Better still, develop profiles of your program in design and operation, compare these with the profile of a quality teacher development program (Resource A), and share your findings with your administrator.

Any option you select that shows your administrator you are relying on more than your own experience and opinions will make you seem less defensive. Usually, sponsors quickly come to appreciate the complexity of professional development programs and outcomes when presented with the philosophy inherent in *profiling program quality.*

4. *Some outcomes, like changes in student attitudes toward science and mathematics, are difficult to measure. How do we handle those?* For two reasons, we sometimes find an outcome difficult to measure or investigate. First, our own thinking is not clear about what we want to measure. Second, we do not have the measurement tools available. Attitudinal measurement is an example of both. What indicates a positive or negative change in student attitude? What evidence would we accept that such an attitude is present? Are measurement tools available? Do we know how to use them?

You have two places to begin. One is to search for possible measurement tools. This search can be streamlined if you already know what information collection methods you can use. For example, you have already decided to survey students by using written questionnaires. It is time-consuming but very possible to find several attitudinal surveys already developed for the target population—say, middle school students. Confining the search to science or mathematics narrows it, but instruments do exist. If you choose this route, then you must review each possible instrument to determine whether it measures the indicators of student attitude that are compatible with your proposed outcome. If none are exactly correct, you may choose to refine your outcome to conform to the tool. You cannot revise the instrument without endangering its validity and measurement reliability—at least not without a lot of time and expertise. One of the most frequent—and potentially dangerous—mismatches between measurement tools and desired outcomes is with student achievement measured by standardized tests. To date, we do not have standardized tests that measure students' understanding well.

Second, suppose you already know that no validated measurement tools exist, or you do not have the resources to use them. In this instance, you must turn to more exploratory and qualitative methods. These are often more authentic as well—like student logs or journals, interviews, or focus groups. These are not tools you pull off the shelf; these are tools you must develop together with analysis rubrics, but lots of models are available for adaptation.

The bottom line is that if you cannot find or develop the measurement tools and analysis rubrics, you must consider refining your outcome. You are most vulnerable to sponsors and the community when you adopt a program outcome you cannot substantiate through a credible investigation.

5. *How can I tell whether a particular outcome is the result of the professional development program we had recently in our school?* It depends on the type of outcome. Intermediate and long-term outcomes are rarely, if ever, the result of a single support program like professional development. Rather, they are the consequences of sustained school improvement and reform initiatives composed of several programs. Short-term outcomes are those that might be ascribed or attributed to a particular support program such as professional development. You should be able to tell whether a particular short-term outcome—like teachers' increased knowledge and understanding of science or the National Science Education Standards—is the result of your professional development program if you have investigated teachers' knowledge and understanding before and at the end of the program by using credible tools and methods and compared your preprogram and postprogram measurements.

6. *In our district, the people who run the programs also investigate their outcomes. Isn't this like having the fox guard the hen house?* It could be, but not necessarily. The audiences for information on program outcomes are almost always sponsors and communities (in addition to program directors and staff). Sponsors, particularly outside sponsors like state and federal offices, often have a preference for information provided by external or third parties—parties not associated in any way with a program's operations. They believe that the information is more objective and, therefore, more credible. NCISE often serves as the external or third party gathering program information on outcomes for sponsors and communities.

Your district may see program outcome information gathered internally as credible. Even if the information is gathered by program staff, the district should assure itself that the methods and tools used to collect and analyze the information meet generally acceptable standards for such investigations. The district should approve the program's investigation plan just as it approves its design and operations plans. Cost is often a factor in using external parties to gather program outcome information. Sometimes a district will engage an external consultant to develop the investigation plan and then audit the investigation to ensure that general acceptable standards are followed.

If the district's intent is to develop a model or exemplary program for replication in other districts, using external parties to collect and analyze program outcome information is a must. Most sponsors and other communities will require the objectivity and assurances that come from using external parties.

7. *If our expected outcomes do not occur, is the program at fault?* If your program is one of the four types we profile in this book and if the expected outcomes do not occur, you should ask yourself the following questions: First, are you absolutely certain that your program design reflects all the components of a quality program? If not, you have redesign work to do. Second, are you equally certain that your program operations also reflect all the components? On closer examination, you could find that operations slipped and need to be more tightly monitored. Third, on reconsideration, are your expected outcomes reasonable for the type of program you have undertaken? You may have identified an outcome that seemed reasonable but may not be. There are two reasons for this: (a) You may not be able to investigate the outcome credibly (the tools may not be appropriate); or (b) the environment changed and the necessary supportive factors are not present as planned. In either case, you will have to adjust your expectations.

If you can answer yes to all three questions and not find an area of the program or the investigation plan to revise, your situation is very rare. *Profiling program quality* was developed to avoid this situation and has been very successful. Most of the time, program directors and staff find that a portion of their program is not well-designed or operating according to the components of a quality program or that their expectations were not completely realistic.

8. *How would I determine reasonable outcomes for a professional development program in another subject area—reading, for example?* Uncovering reasonable outcomes for a program follows the same developmental process as identifying components of a quality program. You must begin with a review and synthesis of the formal and informal literature on professional development programs in that subject area and then add the knowledge of experienced practitioners to your synthesis. Determining reasonable outcomes takes time. The research literature can be unclear or underdeveloped. In these cases, the wisdom of expert practitioners becomes extremely important. Also, professional development programs of many types have some short-term outcomes in common. These are usually some form of increased knowledge, skills, and understandings on the part of teachers.

You are probably seeking to identify specific outcomes within general types that apply to your subject area.

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Resources

Resource A

Profile of a Quality Teacher Development Program

1. **Vision for the Teacher's Classroom**[1,31]
    a. The content of teaching and learning is:
        - Big ideas in science and mathematics
        - Scientific attitudes
        - Scientific and mathematical skills
    b. The process of teaching and learning is a "hands-on/minds-on" instructional approach that includes student investigation, discovery, and application of relevant science and mathematics
    c. Teacher's primary roles are facilitator, coach, and mediator
    d. Teaching and learning are cooperative and collaborative
    e. Teachers use materials, strategies, and perspectives sensitive to diverse:
        - Cultures
        - Languages
        - Genders
        - Learning styles
    f. Teachers and students engage in ongoing authentic assessment of important learning outcomes
    g. Other

2. **Teacher Development Program Activities**

   a. Model elements of the vision of the classroom (see component 1, a-f) through:

      - Content (1.a)
      - Process (1.b)
      - Teacher role (1.c)
      - Collaborative learning (1.d)
      - Sensitivity to diversity (1.e)
      - Assessment (1.f)

   b. Are appropriately designed for adult learners[7,23]

      - Relevant and practical
      - Focus on teachers' interests and concerns
      - Link teachers to resources and support

   c. Model teaching principles and strategies that can be transferred to the classroom[27]

   d. Include the use of tools, methods, and processes of scientists[27]

   e. Include actual or simulated problems or challenges of "real world" science and mathematics[27]

   f. Include opportunities to practice new classroom behaviors or strategies[22,25]

   g. Include opportunities for teachers to work together as they learn and plan for transfer to their individual classrooms[25]

   h. Other

3. **Unique Contribution of the Host Organization**

   a. Scientists, mathematicians, engineers, and technicians

      - Participate in program design, implementation, and evaluation
      - Assist in developing scientific/mathematical/technical content
      - Collaborate with teachers to solve real/simulated problems
      - Serve as role models (minorities, women, physically challenged, senior/retired)

   b. Scientific/mathematical/technical facilities and equipment are used for training, immersion, and mathematics and science experiences

   c. Scientific and mathematical focus of the organization is reflected in teacher development activities

   d. Other

4. **Follow-Up**

   a. Learning activities for teachers are spread out over time[15,27]

   b. Teachers have the opportunity to try out their new knowledge and skills in classrooms before follow-up occurs[22]

   c. Follow-up focuses primarily on the use in the classroom of teachers' new knowledge and skills[22]

   d. Follow-up takes a variety of forms, including additional training, problem-solving meetings, on-site or telephone consultation, networking through newsletters or telecommunications, training and support of local resource teachers or others to provide ongoing assistance[27]

   e. Long-term commitment to teachers includes support from the host organization in partnership with the school and/or community[27]

   f. Other

5. **Teacher Leadership and Responsibility**

   a. Teachers have input or involvement in decisions about the content, process, and delivery of their learning experiences[25]

   b. Teachers take on leadership responsibilities in aspects such as implementation, follow-up, and dissemination to their colleagues[16]

   c. Teachers are given support by the host organization for leadership and networking with people outside the program, such as teacher colleagues, community members, and professional associations[27]

   d. Other

6. **Systemic Connections**

   a. The program links to a larger systemic effort and

      - Is a key component of the strategic plan driving the systemic effort
      - Has clear goals and objectives consistent with those of the larger systemic effort
      - Is based on needs identified by the major education stakeholders served by and involved in the systemic effort
      - Has content and activities that complement other programs in the larger systemic effort
      - Works to combine program resources with those of partners and participants' schools to sustain program impact over time
      - Is aligned with local, state, and national standards and articulates that alignment in all aspects of the program

  - Ensures equity based on race, ethnicity, sex, and disability in its provision of resources, in its staffing, and in the program perspective, content, and materials

b. The program promotes continued use of what participants learn by:

  - Teachers attend in pairs or teams
  - Teacher teams develop a plan to implement and disseminate new strategies and learning
  - Teachers develop professional relationships with each other and network over time
  - Program staff, teachers, and their school/district work together to make specific connections to other efforts in the school/district/state and the teachers' ongoing professional development
  - The teachers' school/district commits to and provides support for implementation of new strategies and learnings
  - Additional resources are identified and available to continue program support once the funding ends

c. Other

7. **Program Administration**

a. Articulates clear program goals that are understood by all[13,27]

b. Aligns all activities with program goals

c. Clearly defines roles and responsibilities of all staff

d. Includes teachers, scientists, mathematicians, engineers, educators, and administrators in program design[27]

e. Has adequate resources that are well managed

f. Creates collegial atmosphere[26]

g. Ensures effective preprogram interaction with participants

h. Communicates with and reports regularly to the sponsor

i. Maintains database of participant information for reporting and ongoing communication

j. Establishes relationship with teachers' school/district prior to the program[3,27]

k. Maintains relationship with teachers' school/district during and after the program[3,27]

  l. Designs and conducts participant recruitment so that teachers representing the target population (e.g., those teaching students from underused groups) are reached

  m. Other

8. **Program Evaluation**

  a. Monitoring occurs during the program[13,27]

  b. Participants have opportunities to provide feedback and input during and after the experience

  c. Ongoing formative evaluation involves data collection from a variety of sources[13,27]

  d. Pre- and postprogram assessments gather information about impact on participants

  e. Program administrators use evaluation results to make changes[13,27]

  f. Other

Resource B

Profile of a Quality Teacher Research Program

1. **The Teacher's Research Experience**[19]
    a. Has a well-defined research task that is integral to, or a spin-off of, the mentor's ongoing research
    b. Has been designed for success with respect to teacher skills and capabilities
    c. Includes elements of the research process, such as:
        - Designing experiments
        - Creating mathematical models
        - Collecting, analyzing, and synthesizing data
        - Keeping a research journal
        - Communicating results[11,19]
    d. Incorporates the research process, with uncertainties, false starts, and loose ends[19]
    e. Involves technologies new to the teacher[19]
    f. Involves an understanding of the broader context and the scientific literature of the research project
    g. Involves presentation of results for peer review (scientists, mathematicians, and teachers)[11]
    h. Makes the teacher part of the research team, modeling the interdependence of team members[19,33,35]

   i. Provides opportunities for updating teacher knowledge and skills[11,35]
   j. Other

2. **Teacher Assignments**
   a. Are made by individual(s) with science and mathematics backgrounds
   b. Relate to the host organization's mission, unique capabilities, and core competencies, including
      - Applied and basic technologies
      - Integration activities
      - Product realization[19]
   c. Match backgrounds and research interests of the teacher
   d. Other

3. **Mentor Assignments and Role**
   a. Mentors are selected to have time, interest, and ability to talk with teachers at appropriate level[4,21,33]
   b. Mentors are inducted into the role and supported throughout the experience[4,21]
   c. Mentors are available for interaction and support or arrange for equally or more suitable substitute(s)[4,19,35]
   d. Other

4. **Preparation**
   a. Teachers are oriented to their role and the host organization's working environment and the sponsor's mission and competencies
   b. Teachers have clear expectations of what the experience will involve[19]
   c. Mutual expectations are established in advance through mentor/teacher direct contact[19]
   d. Mentors suggest readings and other prework accessible to teachers before arrival
   e. Facilities and working conditions required by teachers to do the assigned research are identified and prepared in advance
   f. Teachers receive advance communication about housing, transportation, and other logistics
   g. Other

5. **Broader Host Organization Experiences**

   Organization staff ensure:

   a. Teachers get a broad exposure to multidisciplinary scientific and mathematical topics central to the mission of the host organization

   b. Teachers are regular participants at meetings and have opportunities to interact with other teachers, scientists, and mathematicians[19,33]

   c. Teachers are exposed to a variety of scientific, mathematical, and technical careers[19]

   d. Teachers have opportunities and mechanisms to reflect on their research experience and how it might transfer to their classroom. Mechanisms can include:

      - Reflective journals
      - Group discussions

   e. Teachers receive specific assistance and suggestions for transferring both the process and context of the research experience to the classroom[11,35]

   f. Other

6. **Follow-Up**

   a. Mechanisms are created to encourage teachers to continue to communicate with the host organization, mentor, and scientific, mathematic, and academic communities after the experience; teachers have continued access to resources and information[11,33,35]

   b. Teachers receive appropriate recognition from the host organization and program administration[26]

   c. Host organization encourages recognition of teacher by school and district[3]

   d. Teachers receive advice and support for external presentation of research results[1]

   e. Teachers receive advice and encouragement for sharing experience and educational spin-offs with educators and community and for encouraging other teachers to apply[19]

   f. Teachers receive advice and support for assuming leadership positions in district/professional associations[27]

   g. Teachers receive support for extending experience to the classroom during school year[11,35]

   h. Other

7. **Systemic Connections**
   a. The program links to a larger systemic effort and:
      - Is a key component of the strategic plan driving the systemic effort
      - Has clear goals and objectives consistent with those of the larger systemic effort
      - Is based on needs identified by the major education stakeholders served by and involved in the systemic effort
      - Has content and activities that complement other programs in the larger systemic effort
      - Works to combine program resources with those of partners and participants' schools to sustain program impact over time
      - Is aligned with local, state, and national standards and articulates that alignment in all aspects of the program
      - Ensures equity based on race, ethnicity, gender, and disability in its provision of resources, in its staffing, and in the program perspective, content, and materials

   b. The program promotes continued use of what participants learn by:
      - Teachers attend in pairs or teams
      - Teacher teams develop a plan to implement and disseminate new strategies and learning
      - Teachers develop professional relationships with each other and network over time
      - Program staff, teachers, and their school/district work together to make specific connections to other efforts in the school/district/state and the teachers' ongoing professional development
      - The teachers' school/district commits to and provides support for implementation of new strategies and learnings
      - Additional resources are identified and available to continue program support once the funding ends

   c. Other

8. **Program Administration**
   a. Program goals are clearly stated and understood by all
   b. Clear assignment of responsibility for program administration
   c. Employs trouble-shooting mechanism ensuring careful monitoring of mentor-teacher relationship and corrects mismatches early on[4,21]

d. Has adequate resources that are well managed

e. Encourages applications of teachers from groups underrepresented in science, mathematics, and technology fields

f. Creates collegial atmosphere[11,26,33]

g. Ensures preprogram interaction of host organization and mentors with participants[19]

h. Plans carefully for housing and other logistics (e.g., transportation, information about the community)

i. Communicates with and reports regularly to sponsors

j. Maintains database of participant and mentor information

k. Selects teachers for compatibility with host organization mission and mentor specialization and work style

l. Programs are of sufficient time duration to allow:

- Orientation to the host organization environment and research context
- Time to accomplish the assigned task
- Communication and presentation of results

m. Other

9. **Program Evaluation**

a. Monitoring occurs during program[19,20]

b. Participants and mentors have opportunities to provide feedback and input during and after the experience[19,20]

c. Ongoing formative evaluation involves data collection from a variety of sources[19,20]

d. Pre- and postprogram assessments gather information about impact on participants

e. Program administrators use evaluation results to make changes[20]

f. Other

Resource C

Profile of a Quality Student Enrichment Program

1. **Program Design**
    - a. Program goals are clearly defined and understood by all[24]
    - b. Program is designed to reflect the findings of research and knowledge of best practice
    - c. Teachers, administrators, scientists, mathematicians, and others are involved in program design and implementation[27]
    - d. Host organization or other program environment is safe and supportive
    - e. Program interacts, collaborates, and networks with other programs, local school districts, and universities, as appropriate
    - f. Other
2. **Student Selection**
    - a. Clear criteria related to program goals are established and used for student selection
    - b. Criteria for selection include the support of a teacher or mentor from school or community before program (for recommendation) and after (for continuous application of learnings from program)[24,35]
    - c. Active outreach and recruitment targets students who are at-risk and those from groups underrepresented in science, mathematics, and technology
    - d. Other

3. **Preparation**
   a. Students are oriented to their role and the nature of their experience, to the host organization, and to the sponsor's mission and competencies, using grade-level-appropriate language
   b. Program administrator(s), students, teachers, and parents establish mutual expectations in advance
   c. Students receive background materials or orientation in advance
   d. Students receive advance communication about logistics and housing, when appropriate
   e. Program establishes relationship with students' teachers, schools, and/or districts
   f. Program selects, orients, and trains program staff and associates to ensure that they understand the goals and nature of the program and apply the most appropriate knowledge, skills, attitudes, and strategies to their work with student participants[12]
   g. Other

4. **Program Activities**
   a. Complement or enhance students' current science, mathematics, and/or technology curriculum
   b. Involve students in actually doing science and mathematics through using tools, methods, and processes of scientists and mathematicians; demonstrate that research has unknown outcomes, uncertainties, and loose ends[5,17,38]
   c. Are appropriate for individual student's developmental level, capability, gender, cultural background, technical skill, interests, language, and learning style[38]
   d. Are challenging, engaging, exciting, and fun[17,38]
   e. Involve new technologies
   f. Have definable end-products for students, such as projects and presentations to peers[5]
   g. Assign students to a team, modeling interdependence and collegiality (if a research experience, students join an existing research team of scientists, mathematicians, and/or other host organization staff)[14]
   h. Assign student or groups of students mentors for guidance, support, structure, role modeling, etc.[8,12,14]

i. Provide opportunities for developing knowledge of important science and mathematics concepts, skills, and "habits of mind"[5]

j. Expose students to variety of careers identified through research on future job market[17]

k. Provide opportunities for students to develop career life planning skills

l. Pay special attention to building individual self-confidence and interpersonal skills[8]

m. Include assessment of students' work for the purpose of giving them feedback on the quality of their work[8]

n. Other

5. **Unique Contribution of the Host Organization**

a. Scientists, mathematicians, engineers, and technicians:

- Participate in program design and implementation
- Assist in developing scientific/mathematical/technical content
- Work with students to solve real/simulated problems
- Serve as role models

b. Scientific/mathematical/technical facilities and equipment are used for training, immersion, and experiences

c. Student activities relate to the host organization's mission, unique capabilities, and core competencies

d. Other

6. **Follow-Up**

a. Mechanisms such as newsletters and electronic mail enable communications between students and between students and scientists/mathematicians/technicians; students continue to have access to resources and information of the host organization

b. Host organization gives students appropriate recognition (e.g., ceremony, awards, T-shirts); host organization encourages recognition by school and district (e.g., press releases, ceremony)

c. Host organization provides advice, support, and encouragement for students to share enrichment experience with others and assume leadership roles (e.g., through tutoring, presentations)

d. Host organization maintains commitment, contact, and support to students to provide them information on additional opportunities and encourage them to pursue and/or consider science, mathematics, and engineering careers

e. Other

7. **Systemic Connections**

a. The program links to a larger systemic effort and

- Is a key component of the strategic plan driving the systemic effort
- Has clear goals and objectives consistent with those of the larger systemic effort
- Is based on needs identified by the major education stakeholders served by and involved in the systemic effort
- Has content and activities that complement other programs in the larger systemic effort
- Works to combine program resources with those of partners and participants' schools to sustain program impact over time
- Is aligned with local, state, and national standards and articulates that alignment in all aspects of the program
- Ensures equity based on race, ethnicity, gender, and disability in its provision of resources, in its staffing, and in the program perspective, content, and materials

b. The program promotes continued use of what participants learn by:

- Program staff coordinate with teachers of student participants in the preparation of students, as well as follow-up and reinforcement of their learning
- Several students from a single school attend, rather than single students from several schools
- Teachers from the students' schools participate in selected aspects of the program

c. Other

8. **Program Administration**

a. Is clearly assigned as the responsibility of one or more persons

b. Involves parents as much as possible and in as many ways as appropriate[24]

c. Communicates with and reports regularly to the sponsor

d. Maintains database of applicant and participant information

e. Other

9. **Program Evaluation**
    a. Monitoring occurs during program
    b. Students and mentors have opportunities to provide feedback and input during and after the experience
    c. Pre- and postprogram assessments gather information about impact on students
    d. Program administrators use evaluation results to make changes
    e. Other

Resource D

Profile of a Quality Systemic Program

1. **Vision of the Systemic Effort**
    a. Is shared and articulated by all relevant stakeholders[10,32]
    b. Includes an ambitious set of learning goals for all students that are based on national and state standards[29]
    c. Other
2. **Nature of the Partnership**
    a. Includes major stakeholders, representing the key groups within the community that are concerned with schools and youths[29,30]
    b. Has a governance and management structure with clearly defined roles, responsibilities, and accountability[13,23]
    c. Has a collaboratively developed strategic plan with sufficient detail for short- and long-term implementation[29,30]
    d. Leverages resources, drawing on strengths of each partner[29,32,37]
    e. Communicates regularly and frequently[39]
    f. Involves risk taking by all partners[39]
    g. Each partner commits to the vision and its individual role in achieving it; makes changes in its own institution toward achieving vision[30,39]
    h. Establishes good working relationships and trust among partners[37]
    i. Other

3. **Direct Delivery Interventions**

   Designs and delivers specific interventions for practitioners, such as:

   a. Training, workshop opportunities[27,28]

   b. Consultation[27]

   c. Resource center

   d. Other

4. **Changes in Policies and Support for Reform**

   a. Resource reallocation[18,41]

   b. School structures and governance to support local autonomy for implementation[10,18,28,41]

   c. Teacher preparation and induction[32,41]

   d. Professional development and ongoing assistance[18,27,28,32,41]

   e. Assessment[41]

   f. Other

5. **Unique Contribution of the Host Organization**

   a. Assists in developing scientific/mathematical/technical content

   b. Scientific/mathematical/technical staff serve as teachers, mentors, guides, resources for activities sponsored by the systemic effort

   c. Facilities and/or equipment are used for learning science, mathematics, and technology

   d. Scientific/mathematical/technical contributions include frontier science and mathematics content and state-of-the-art tools and methodologies, including use of technologies for communication and learning

   e. Scientific/mathematical/technical staff serve as role models, including representation of underrepresented populations

   f. Other

6. **Alignment of the Educational Program**[18,40,41]

   a. Curriculum and materials, instructional strategies, and assessment are aligned with the vision

   b. Curriculum and materials, instructional strategies, and assessment are aligned with each other[32]

   c. Curriculum and materials, instructional strategies, and assessment are aligned with best practice

   d. Curriculum and materials, instructional strategies, and assessment are aligned with national, state, and local standards
   e. Other

7. **Strategies Promoting Equity**[18,41]
   a. Recruitment and selection of participants are equitable
   b. Resources are allocated equitably[28]
   c. Programs and practices that have demonstrated success with females and minorities are used[28]
   d. Instructional strategies and materials are culturally sensitive
   e. Diversity is valued for the richness it brings
   f. Other

8. **Public Support**
   a. Specific communication and engagement strategies are used to involve noncollaborating stakeholders (e.g., legislators, special interest groups, public) in the effort[18,28,29,41]
   b. Other

9. **Building the Capacity of the System**
   a. Attention to creating and institutionalizing an infrastructure for change and renewal[28]
   b. Attention given to broadscale development of skills in leadership; collaboration; change management; and systems concepts, disciplines, and tools[2,18,34,36]
   c. Active networking among participants and with other change efforts[28]
   d. Attention to dissemination
   e. Other

10. **Evaluation, Feedback, and Continuous Refinement**
   a. Both quantitative and qualitative data are gathered on a regular basis for both formative and summative evaluation[6,10,30]
   b. Data are analyzed against benchmarks and expected outcomes, defined by the vision[10]
   c. Partners engage in regular reflection and make changes based on data
   d. Other

11. **Program Management**
    - a. Leader(s) articulate vision, oversee and manage components of the strategic plan[34,36]
    - b. Centralized fiscal system operates efficiently and effectively
    - c. Ongoing attention to political issues[6]
    - d. Model behaviors and strategies of collaboration, risk taking, continuous reflection, and quality[36]
    - e. Specific plan for institutionalizing major components at end of the current funding period
    - f. Other

Resource E

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Resource F

Teacher Development Program: Comparing Three Profiles of the Vision for the Teacher's Classroom Component

The following is an example of comparing the profiles of the program design and program in operation with the profile of a quality teacher development program. The example is of the *vision for the teacher's classroom* component. A brief commentary on the results of comparing the three profiles follows.

Teacher Development Program: Institute in Materials Science and Technology

Profile of a Quality Teacher Development Program	*Profile of the Program Design*	*Profile of the Program in Operation*
1. Vision for the Teacher's Classroom	1. Vision for the Teacher's Classroom	1. Vision for the Teacher's Classroom
a. The content of teaching and learning is: • Big ideas in science and mathematics • Scientific attitudes • Scientific and mathematical skills	a. The institute is designed so that participants explore scientific principles such as classifying materials as metallic or nonmetallic, crystalline or amorphous, chemical bonding and crystal structure, and understand such properties as mechanical strength, thermal and electrical conductivity, and polarization. Teachers will encourage students to use skills such as experimenting, problem solving, and handiness* through designing, fabricating, and producing projects. Through experimentation, problem solving, and projects, teachers will be able to foster the understanding of the links among ceramics, glass, polymers, metals, and composites. The in-depth study of the nature, properties, behaviors, and applications of materials will assist students in making the connections of science, mathematics, engineering, and technology to their world. (*Handiness is the ability to solve materials-related problems with available or limited resources.)	a. As intended. Participants experienced the importance of having a supportive environment that allowed them to take risks. Participants wrote in their journals that being allowed to make mistakes/errors was an important part of their learning process. Technology teachers experienced the importance of having the science background; and science teachers, the importance of hands-on and how the two are partners in materials science and technology (MST). As intended. Participants applied science. Through alloying metals, making glass, and synthesizing polymers and composites, participants were given both content and process related to these areas of investigation. The presentations by scientists and laboratory experiences tie "real science" to the classroom.

b. The process of teaching and learning is a "hands-on/minds-on" instructional approach that includes investigation, discovery, and application of relevant science and mathematics.	b. Teachers will use a multi-instructional approach in their classrooms so that all students can be successful. This approach includes team teaching, guiding of student projects, students working in groups, problem solving, using a laboratory journal as a tool for learning, creativity and risk taking being fostered, students developing handiness, and using community resources.	b. Participants were actively engaged in a hands-on/minds-on instructional approach modeling investigation, discovery, and application of materials. Participants experimented with metals, glass/ceramics, polymers and composites, testing their behaviors and properties. They designed and built projects of one or more materials, thinking about the cost, the feasibility of the construction, the materials, and the aesthetics in relation to the use of the project. All this they could transfer to the classroom. Trying to balance content and process is a constant struggle. Participants have different educational backgrounds and learning styles. The makeup of the institute participants mirrors many classrooms.
c. Teacher's primary roles are facilitator, coach, and mediator.	c. Teachers will function more as facilitators, coaches, and mediators than the authority with all of the right answers who imparts his or her knowledge to the students.	c. Scientists and mentor teachers were models and guides for the participants. Work was planned cooperatively, and presentations by the scientists were tied in to the "real life" science that participants were doing. At least one scientist and mentor teacher were always available to the group.

(Continued)

Teacher Development Program (Continued)

Profile of a Quality Teacher Development Program	*Profile of the Program Design*	*Profile of the Program in Operation*
d. Teaching and learning are cooperative and collaborative.	d. Participants will conduct much of their work in a cooperative group. All work will be done in a collaborative manner among the scientists, mentor teachers, and participants.	d. Participants formed six cooperative groups to carry out their tasks. Each group defined roles and responsibilities for its members and set up ground rules for feedback. All groups had access to at least one scientist and mentor teacher at all times. Groups sometimes worked together or exchanged members to gain needed expertise. From time to time, participants formed other groups or worked in pairs or individuals. Each group completed its tasks by the end of the institute, with each individual completing a product.
e. Teachers use materials, strategies, and perspectives sensitive to diverse: • Cultures • Languages • Genders • Learning styless	e. Multi-instructional approach demonstrates strategies that reach all students.	e. No single learning style works for all learners. Mentors modeled a multi-instructional approach. Participants worked in cooperative groups that varied in configuration (e.g., all female, mixed, all male). People with diverse academic and cultural backgrounds shared their knowledge in pairs, etc. One-on-one instruction was done when appropriate for the participant(s). Use of new tools and equipment was covered in the beginning of the institute, and extra time was given to participants who were uneasy to build their confidence. Peer teaching was encouraged between and among teams (e.g., mixing and pouring glass, working on polymer projects).

f. Teachers and students engage in ongoing, authentic assessment of important learning outcomes.	f. Teachers begin to develop alternative assessment strategies, such as examining student journals, projects, research papers, oral presentations, and laboratory observations.	f. Journals were a major focus. Mentor teachers modeled the use of journals, team work, and laboratory observation in conducting lessons and shared assessment techniques. Participants saw the journals as means of assessment, a way for students to help other students. Participant journals confirmed an understanding of alternative assessment strategies. _____ presented a session on assessment as a part of the institute. The handbook includes a section on assessment.
g. Other. Emphasis is on linkage of creativity with practical reasoning.	g. Activities foster imagination and fantasy as pathways to creativity and innovation while at the same time emphasizing step-by-step practical reasoning to solve problems.	g. Participants experienced trying out new projects and taking risks in a supportive environment. Projects were well received; excellent products were designed and made. An evening presentation focused specifically on creativity. Teachers experienced the importance of the projects to get students "hooked" into wanting to know and understand more about materials.

Commentary: This component of quality teacher development programs has been the most difficult for program directors and staff to capture. Because teacher development programs are designed to influence teachers' classroom behavior, descriptors in the second column (Profile of the Program Design) are the program staff's vision of what teachers will do when they return to their schools. The third column (Profile of the Program in Operation) captures the teachers' perceptions of what they will do. There is also an underlying assumption that teachers need to learn the way the program wants them to teach their students. As a result, activities need to be reflexive.

This example does a reasonably good job of capturing the essence of the vision for the teacher's classroom. It is not exemplary, however. Here are two things to note:

- Throughout the responses to the program in operation appear to be what the program staff think teachers will do on return to their classrooms—rather than what the teachers think they will do. This raises the question of the source of the data for the description of the program in operation. Were teachers interviewed regarding their vision of their classrooms? Descriptions of the program design and the program in operation, however, indicate that the instruction was reflexive (the staff taught teachers the way they wanted teachers to instruct their students).
- Two descriptors are extremely complex, with multiple parts that program personnel did not accurately capture. Descriptor *a* (the content of teaching and learning is big ideas in science and mathematics, scientific attitudes, and scientific and mathematical skills) and descriptor *e* (teachers use materials, strategies, and perspectives sensitive to diverse cultures, languages, genders, and learning styles) are difficult to capture in inclusive yet concise language. In descriptor a, the program design tends to cite concepts or principles, whereas the corresponding description of the program in operation (third column) contains more "habits of mind." In descriptor *e*, the program design lacks detail. A reader has no idea what the program intends to do. Although the description of the program in operation does cite specific strategies, which strategy addresses which aspect of multicultural education is unclear. Also, using same-sex groups is not a model strategy and may be a violation of Title IX (Education Amendments of 1972), depending on how the groups are formed.

On the whole, program directors and staff nicely described the program design for this component of a quality teacher development program, and their instruction was consistent with their vision for the teachers. Although data here (and elsewhere) indicate that teachers enjoyed and learned from the instruction they received, we do not know the extent to which they believe that they can (or want to) incorporate these same approaches into their own teaching.

Resource G

Teacher Development Program: Comparing Three Profiles of the Program Administration Component

The following is an example of comparing the profiles of the program design and program in operation with the profile of a quality teacher development program. The example is the ***program administration*** component of an actual teacher development program we examined. The program director and staff slightly modified the wording of the descriptors in this component for their own purpose without altering their meaning. A brief commentary on the results of comparing the three profiles follows.

Teacher Development Program: Institute in Materials Science and Technology

Profile of a Quality Teacher Development Program	*Profile of the Program Design*	*Profile of the Program in Operation*
1. Program Administration	1. Program Administration	1. Program Administration
a. Articulates clear program goals that are understood by all	a. Institute goals are stated in application. The goals are reiterated to the teachers within the first days of the institute and reviewed periodically during the 20 days. Application clarifies definition of technology education instructor to avoid misunderstanding of "educational technology."	a. As intended. The teachers understood the goals of the institute as stated in the application and reviewed during the institute. One question on the final evaluation asked teachers to list the benefits of starting MST (materials science and technology) in their school or district. Answers to this question reflected the goals of the institute. In addition, participants saw the program as offering them a chance to take risks and to be creative. Scientists saw the program as a means for teachers to make science more relevant to their students. Need to continue to revise application to ensure makeup of the teams fits goal of having MST taught by a science and technology teacher—a team teaching approach.
b. Is clearly assigned as the responsibility of one or more persons	b. J__ D__ is the program coordinator for the institute and has primary responsibility for planning and administration. G__ W__, precollege faculty fellow, is involved in most aspects of the institute planning.	b. As intended. J__ D__ is recognized as the program coordinator and manager of the overall conduct of the institute. Teachers came to J__ with requests for information, questions about the MST curriculum, and any concerns related to (host organization).

c. Includes teachers, scientists, educators, and administrators in program design	c. Collaborative effort of science educators, mentor teachers, and (host organization) scientists and engineers to redesign presentations for more applications of concepts. Shorter presentations, more active involvement of scientists and engineers planned compared to last summer's institute.	c. As intended. Third-year review of the handbook by (host organization) staff and mentor teachers added examples of "need to know" questions, new experiments, and reorganized certain areas based on recommendations of an external reviewer. Planning for the institute was done through two weekend meetings and conference calls. The format of the institute was changed to facilitate the sequencing of instruction. Mentors thought this was a positive change.
d. Creates collegial atmosphere	d. Scientists and teachers collaborate on experiments and projects. Special introductory activities are planned, including a picnic and group lunches. Mentor teachers are housed at the same location as the participants. Scientists are invited to meals.	d. Comments on evaluations and in journals on developing an understanding of scientists and the work they do. Teachers gained an appreciation for "higher-ups in scientific fields; most we met were people, too."
e. Ensures effective preprogram interaction	e. Planning meetings are scheduled for institute staff. Program coordinator communicates with institute staff and participants by letter and phone. Trifold brochure mailed to participants with information about institute, including important phone numbers, housing details, dress suggestions, etc. Articles on MST education sent to all participants.	e. As intended. Based on participant feedback, the 1994 brochure included more detail on the items to bring to the institute to use in the laboratory. Teachers brought tools and aprons, for example. Evaluation comments did point out that some participants wanted more pre-institute information.

(Continued)

Teacher Development Program (Continued)

Profile of a Quality Teacher Development Program	*Profile of the Program Design*	*Profile of the Program in Operation*
f. Ensures effective program follow-up	f. Program staff will communicate through periodic mailings and phone calls with the institute participants.	f. Mentors, participants, scientists, and program staff provided addresses, phone numbers, and e-mail addresses. Scientists expressed a willingness to answer questions as they arise during the year. A 5-year follow-up survey is being developed. Program staff are also working with the University of _____ to plan a statewide symposia for MST teachers. Invitations will be sent to all past institute participants to meet at the _____ conference in March 1995, where (host organization) is presenting a 6-hour workshop on MST.
g. Communicates with and reports regularly to (funding agent)	g. As program manager, J__ D__ regularly reports to (funding agent). (Funding agent) makes one site visit every other year to institute.	g. Regular reports filed with (funding agent). Content of the reports comes from, in part, profiling, surveys, and other evaluative efforts. (Funding agent) did not visit this year (no travel money available).
h. Maintains database of participant information	h. Institute files in program coordinator's office contain all information. Secretary maintains a database of addresses.	h. Established practice. Database contains home and school address, grade and subjects taught, and year they participated in the institute.

i. Establishes relationship with teachers' school/ district	i. Letters of support are required from district administrator and school principal. An administrator/counselor serves on each team. Program coordinator follows up with district staff to maintain relationship. Follow-up relationship established that includes Internet where available, letters, newsletters, etc.	i. As intended. School districts participated as teams. One high school principal, one assistant principal, two counselors, and one district vocational specialist. Administrators claimed they benefited from being part of the institute. The 1994 teams did not all have administrators on the teams; some dropped out at the last minute. In planning the application for 1995 and in reviewing the applications, the importance of having an administrator will be emphasized.
j. Designs and conducts participant recruitment such that teachers representing and serving underserved populations are reached	j. Application materials encourage school districts to include teachers representing and serving underserved populations.	j. As intended. Participants included two Hispanic teachers and one African American. Nine women participated this summer, fewer than in past years. Part of the problem was that two women withdrew from their team a few weeks before the institute and were replaced by men. One district that participated has a school population that is 90% Hispanic.
k. Other. (Host organization) establishes relationship with school district's industrial or university partner	k. Letters of support are required from materials-based partner located in proximity to school district. Letter(s) to industry or university included as follow-up.	k. All teams had letters of support from an industry or university partner. Project staff sent a follow-up letter to all the industrial partners whose letters were included in the team application packets. Names of the district participants were included, as well as suggestions of what they could do to support the teachers in the partnership. Program staff plans to follow-up with industrial partners during the 1994-95 school year.

Commentary: On the whole, descriptions of the program design and the program in operation for this component are well done. Most descriptions in the second column (Profile of the Program Design) appear to be authentic manifestations of the description of a quality teacher development program. There are some possible exceptions:

- Descriptor *c* fails to specify just how the scientists and engineers are to be involved.
- Although the social aspects of a collegial environment are clear, the professional aspects are not. Collaborating on experiments and projects needs more explanation.
- The program design description for follow-up (descriptor *f*) is weak. It raises questions: What is this program's history on follow-up? Do teachers come from geographically diverse locations, so any follow-up is difficult? Can participants attend more than 1 year? More information is needed to judge this descriptor.
- Descriptor *j* also appears to be an inauthentic manifestation of effective practice. Generally, written materials alone are not effective in increasing the participation of teachers representing underserved populations.

In looking at both the program design and the program in operation and comparing these profiles with the profile of a quality teacher development program, the comparison is, overall, well done. Descriptions of the program in operation generally meet the criteria stated in Chapters 3 and 4: succinct, detailed, purely descriptive, accurate, and credible. In most cases that involve actual or potential problems with the program in operation, the program design is also problematic. For example:

- Descriptions of the program design and the program in operation for descriptor *c* (includes teachers, scientists, educators, and administrators in program design) address different aspects of the program. Were scientists and engineers involved more than the previous year? If so, how? How was the planning actually carried out? Who was involved?
- The program in operation indicates that the teachers learned from the scientists (descriptor *d*), but did the scientists learn from the teachers? Collegiality flows two ways.

- Although detail regarding follow-up (descriptor *f*) is greater for the program in operation, it is still apparent that this aspect of the MST program is weak.
- Descriptor *i* is an instance in which the design was adequate but reality was different from the plan. This raises questions about administrators dropping out. Program staff may need to develop stronger approaches to dealing with this problem if they want building administrators represented in their institute.
- Because we do not know the total number of participants, it is difficult to assess the representation of minority group members and women (two and nine, respectively). How do program staff know that their recruiting efforts are or are not working?

In sum, a few discrepancies among a quality program, the program design, and the program in operation need to be examined. (Those would most likely be discussed in a report that accompanies the results of the comparison of the three profiles.) In addition, some descriptors need a more thorough explanation, especially regarding the way they exhibit inauthentic manifestations of effective practice.

Resource H

Teacher Research Program: Comparing Three Profiles of the Teacher's Research Experience Component

The following is an example of comparing the profiles of the program design and program in operation with the profile of a quality teacher research program. The example is the ***teacher's research experience*** component. A brief commentary on the results of comparing the three profiles follows.

Teacher Research Program: Teacher Research Internships Program

Profile of a Quality Teacher Development Program	*Profile of the Program Design*	*Profile of the Program in Operation*
1. The Teacher's Research Experience	1. The Teacher's Research Experience	1. The Teacher's Research Experience
a. Has a well-defined, research task that is integral to, or a spin-off of, the mentor's ongoing research	a. Assignments are well designed and tend to be integral to the mentor's work with an occasional spin-off of ongoing research.	a. The teachers' work assignments were well constructed. Their work was relevant and closely related to, or part of, the mentors' research. Mentors used the teachers' findings in their own research, papers, and presentations. At least two teachers were helping write papers with their mentors.
b. Has been designed for success with respect to teacher skills and capabilities	b. Projects are matched with attention to teachers' strengths and skills; however, some preparation may be required for teachers to become familiar with specific laboratory use and safety related protocols.	b. Goals were set by teachers and mentors in view of the time constraints and teacher capabilities. Most, but not all, teachers thought the match between their skills, abilities, and interests and their projects was very good. For example, two interviewed teachers were involved in data analysis tasks that drew on their math backgrounds. One common complaint by the mentors is the short timeline to make the teacher placement a meaningful research experience for teachers. (Sometimes a few weeks are taken up with training to get a teacher up to speed on a research project.)

c. Includes elements of the research process, such as: • Designing experiments • Creating mathematical models • Collecting, analyzing, and synthesizing data • Keeping a research journal • Communicating results	c. Teachers work closely with mentors, following the prescribed protocols for the project. They perform the same tasks as the mentors and are guided through the process.	c. Teachers working on independent, supervised projects and those working closely with their mentors were involved in all aspects of the research process, including creating and analyzing databases, collecting and analyzing data, keeping journals, coauthoring papers, testing new techniques, and conducting hands-on experimental work.
d. Incorporates the research process, with uncertainties, false starts, and loose ends	d. Teachers mostly mirror the process experienced by their mentors in doing the research.	d. Teachers were excited to be doing "real" science versus classroom science. On the one hand, "real" science was described as being a slow process that takes a large amount of time, an ongoing process, a process needing and using a large amount of money, a process of intricacies and bureaucracy, including waste. Classroom science, on the other hand, was described as taking place in a limited time class period, using limited resources.
e. Involves technologies new to the teacher	e. Teachers use those technologies appropriate to their projects at their specific sites. They are exposed through tour site visits to many technologies in current use at the lab that are not available at their schools.	e. Teachers had the opportunity to learn about new technologies in their areas of research through direct study, research, and hands-on exposure to computer technology and appropriate software, all aspects of instruments, detectors, and tools appropriate to their research areas, as well as tours of the laboratory facilities.

(Continued)

Teacher Research Program (Continued)

Profile of a Quality Teacher Development Program	*Profile of the Program Design*	*Profile of the Program in Operation*
f. Involves an understanding of the broader context and the scientific literature of the research project	f. Teachers have access to a scientific library and are encouraged to go to original sources.	f. Teachers had the opportunity to review original literature relevant to their research. Most mentors assigned the teachers general or in-depth readings.
g. Involves presentation of results for peer review (scientists and teachers)	g. Teachers report on findings to the groups where their mentors work and to their peers. They present a poster session designed to demonstrate transfer of their research to the classroom or school at an event open to all lab personnel.	g. Not yet occurred.
h. Makes the teacher part of the research team, modeling the interdependence of team members	h. Little research in the lab is done independently. Teachers work with the entire research team, including post docs and technical assistants assigned to the project.	h. Teachers work closely with their mentors or designates as part of the research team. Teachers were included in team discussions, meetings, and seminars. Teachers were invited to team social functions.
i. Provides opportunities for updating teacher knowledge and skills	i. Research is current and frontier breaking. Knowledge and skills develop in concert with the rigors of the research, as well as through supplementary educational activities.	i. Teachers were able to acquire new skills in such areas as computer technology and the use of tools and instruments within their projects' lab sites. They acquired new knowledge in their specific research areas through hands-on exposure, research, and study.

Commentary: This component of the teacher research program appears to be well designed and implemented. The teachers function as team members in the laboratory, working alongside their mentors and other staff actually doing the work of scientists. The work the teachers are doing is not "made-up," but the day-to-day work of the laboratories where the teachers are assigned. As they carry out their work, the teachers acquire a knowledge of the literature base and learn how to use technology, equipment, and materials that are new to them. In essence, each teacher has a full laboratory-based research experience, which is, of course, the purpose of the program.

The descriptions of this component could be strengthened by the addition of examples. General statements describing the actual would come to life with a few specific accounts of the teachers' research, for example. What are the names of the articles being written? What new skills did some teachers learn? Such detail would add some glimmer to text that is a bit flat. There is one omission: *Will* the teachers be making a presentation on their research even though it has not happened yet? Is it at least scheduled, as the intended response indicates?

Resource I

Teacher Research Program: Comparing Three Profiles of the Program Evaluation Component

The following is an example of comparing the profiles of the program design and program in operation with the profile of a quality teacher research program. The example is the *program evaluation* component, which is one component found to be associated with quality programs of several types. A brief commentary on the results of comparing the three profiles follows.

Teacher Research Program: Teacher Internship in Akens Pharmaceutical Laboratory

Profile of a Quality Teacher Research Program	*Profile of the Program Design*	*Profile of the Program in Operation*
7. Program Evaluation	7. Program Evaluation	7. Program Evaluation
a. Monitoring occurs during program	a. Program staff submit to director brief weekly reports documenting any discrepancies between planned and actual activities. Director forwards reports to accounting when there are budget implications.	a. Director reviewed staff weekly reports, noted any implications for the budget, and forwarded reports to the accounting office. Any major discrepancies were discussed in the biweekly staff meetings, and appropriate adjustments in the design were made to ensure achieving program objectives.
b. Participants and mentors have opportunities to provide feedback and input during and after the experience	b. The program director visits teachers and mentors on-site at least three times during the 8-week program. The weekly seminar sessions have built-in time for group discussions with teachers that will surface how things are going for them. At the end of the program, participants will complete an evaluation.	b. Program director actually met with teachers and mentors on-site once a week, sometimes at formal sessions, sometimes at lunch. Made herself available if anyone had special concerns that she or he wanted to address privately. At the beginning of each weekly seminar, teachers were asked how their experiences were going. A few teachers with special situations or concerns have had additional support in resolving scheduling, conflicting expectations, or problems related to their mentors. All teachers completed an evaluation at the end of the program. Results are discussed in the attached report.

c. Ongoing formative evaluation involves data collection from a variety of sources	c. Data for formative evaluation comes from the monitoring reports mentioned previously, completion of this instrument, the evaluation participants complete at the end of the program, and a staff debrief also at the end.	c. Program director and staff used all data sources indicated. See attached report for a detailed discussion of the results.
d. Pre- and post-assessments gather information about impact on participants	d. Participants completed a pre- and postassessment that covered their knowledge of science content and processes as carried out in this research facility. It also addressed the applicability of their research experience to their classrooms.	d. Teachers' scores on the postassessment were significantly higher (see report) in 5 out of 10 areas. Most nonsignificant areas were in the section on applicability of the research experience to their classrooms.
e. Program administrators use evaluation results to make changes	e. Results of the formative and summative evaluations mentioned before will be used to make changes in the program for the next iteration.	e. Data from the formative evaluation point to needed changes in recruiting and matching both participants and mentors. Participants were 90% Caucasian; 20% of mentors were not able to fulfill their commitments; and 10% of participants had to be switched to a different mentor either because of a mentor's unavailability or because the match was not working (see report for additional details). Changes to correct these problems will be implemented next year. Also, staff want to review whether or not applicability to the classroom is a realistic and appropriate goal for this program. If it remains, then the instruction needs to be redesigned. It may be an inappropriate goal that should be dropped.

Commentary: This component on program evaluation is extremely well done in virtually every respect. Detail is sufficient so that a reader has a good sense of how this program carried out evaluation. The level of detail is sufficient to give both depth and credibility to the profile. Notice references to the attached evaluation report, which is an analysis and interpretation of all the data from the program.

The evaluation program distinguishes among monitoring and formative and summative evaluation, clearly addressing all three. The only fuzziness about the evaluation is to what extent mentors participate. If mentors are not providing feedback at the same level as participants, this program may be missing important data. In fact, these data may help explain the difficulties with mentors that they are experiencing. In all, this component is exemplary.

Resource J

Student Enrichment Program: Comparing Three Profiles of the Systemic Connections Component

The following is an example of comparing the profiles of the program design and program in operation with the profile of a quality student enrichment program (Resource C). The example is the *systemic connections* component, which is found in quality programs of several types. A brief commentary on the results of comparing the three profiles follows.

Student Enrichment Program: Borena Valley Science Program—Grades 4-6

Profile of a Quality Student Enrichment Program	*Profile of the Program Design*	*Profile of the Program in Operation*
7. Systemic Connections a. The program links to a larger systemic connection and:	7. Systemic connections a. This program for students in grades 4, 5, and 6 is part of a larger systemic effort. That effort, Improving Science Education in the Borena Valley, is conducted by five partners: the Hoffmantown School District, the Langren School District, the Borena Valley College, the Borena Valley Business and Industry Roundtable, and the Borena Valley Nature Conservancy.	7. Systemic connections a. Program functions as the elementary component of a larger systemic effort involving pre-service and in-service of K-12 staff in two school districts along with external science experience once a year for all students in grades 4-12. The program director is Dr. Lee Travino, who reports to the executive director of the Borena Valley Nature Conservancy and to the partnership, of which the Nature Conservancy is a member.
• Is a key component of the strategic plan driving the systemic effort	This elementary program provides an external immersion experience in science for students in grades 4, 5, and 6.	Fourth graders spend 3 days; fifth graders, 4 days; and sixth graders, 5 days per year on-site at the Borena Valley Nature Conservancy. Here they study various aspects of the Borena Valley Watershed.
• Has clear goals and objectives consistent with those of the larger systemic effort	Program has been developed jointly by the five partners. Its goals and objectives support the larger systemic effort. Students in grades 4-12 have an external science education experience varying from 3 days to 6 weeks once a year.	The goal of the program is to provide students with real-life experiences in science in their community to increase their level of science literacy and to expose them to a wide variety of careers using science.

• Is based on needs identified by the major education stakeholders served by, and involved in, the systemic effort	Prior to this systemic endeavor, students had no involvement in any consistent, planned external science event. Their classroom experience was largely a textbook with a few demonstrations.	The five partners, along with a large advisory board, identified the need for community-based experiences in science for students in grades 4-12. The Nature Conservancy, in conjunction with a planning group of teachers, designed the program. It is evaluated each year, and results of the evaluation are reviewed by the partners and the advisory board to make sure the program meets the identified needs. This program was the outgrowth of stakeholders' vision of science education in the two districts. They wanted a community-based learning experience for all students.
• Has content and activities that complement other programs in the larger systemic effort	Both districts have a content matrix for science that indicates what topics are taught and when in grades 4-6. The external science program for students is provided as the instructional activities designated on the content matrix.	An examination of the districts' content matrices, as well as interviews with teachers, reveals that the external science program is an integral part of the schools' science curriculum. Moreover, the 4-6 program conducted by the Nature Conservancy is aligned with the ones for students in grades 7-8 and 9-12, which are also conducted by the Nature Conservancy.

(Continued)

Student Enrichment Program (Continued)

Profile of a Quality Student Enrichment Program	*Profile of the Program Design*	*Profile of the Program in Operation*
• Works to combine program resources with those of partners and participants' schools to sustain program impact over time	Although the Nature Conservancy is the sponsoring agency, the organization has secured funds from each of the other partners to help conduct these programs (approximately two thirds of their funding). Pending satisfactory performance, their contract with their partners runs for 5 years.	All partners, except the local university, have supported the Nature Conservancy's 4-6 program, according to the terms of the contract. The university has withheld funding, pending working out an arrangement whereby their elementary education students can participate in the program as interns. All parties expect details to be worked out and the matter settled within the next 3 months.
• Is aligned with local, state, and national standards and articulates that alignment in all aspects of the program	Program (content, pedagogy, and materials) will be reviewed for alignment with local, state, and national standards.	Although program content, pedagogy, and materials had not been closely reviewed for alignment when the program started 2 years ago, that process has been going on slowly. Alignment with the districts' curriculum, materials, and assessment is now complete; staff is now working on alignment with the state framework and national standards. Estimated completion time is 6 months.
• Ensures equity based on race, ethnicity, gender, and disability in its provision of resources, in its staffing, and in the program perspective, content, and materials	Program targets two districts with high percentage of students at risk. Core staff of seven consists of two African Americans, one Asian, one Hispanic, and three females. Content, materials, and program perspective have been reviewed for any evidence of bias.	The two districts with the highest numbers of students at risk were selected to participate in this regional systemic initiative. The staff have been well integrated from the beginning; they, along with the teachers, have reviewed the content, materials, and program perspective. They are looking for materials that better reflect the cultural diversity of Borena Valley.

b. The program promotes continued use of what participants learn by:		
• Program staff coordinate with teachers of student participants in the preparation of students, as well as follow-up and reinforcement of their learning	Each classroom teacher attends Nature Conservancy program with students and co-teaches certain segments with staff. Teachers take follow-up units with them on their return to the classroom.	The classroom teachers report that their participation with their class is one key feature of the program. They learn new content and pedagogy and have a chance to practice that in a safe, resource-rich environment. Teachers can call on the Nature Conservancy staff for help in implementing the follow-up units. Under certain circumstances, Nature Conservancy staff will come to a teacher's classroom for follow-up activities.
• Several students from a single school attend, rather than single students from several schools	Students attend with their class. All schools from the two districts participate.	All students participate. If a student is absent at the time his or her class is scheduled, that student participates with another class. If a student misses a significant part of the program, he or she must repeat the experience with another class.
• Teachers from the students' schools participate in selected aspects of the program	In addition to the teaching, a rotating group of teachers from the students' schools participate in the planning of the program. Two teachers, two parents, and two staff members make up the evaluation team for the program.	Teachers were an integral part of this program from its original conception to its annual evaluation. Teachers and Nature Conservancy staff function as colleagues.

Commentary: The purpose of this component is to capture the extent to which a specific program—in this case, the Nature Conservancy's Program on the Borena Valley Watershed for fourth, fifth, and sixth graders—is part of a larger systemic effort. Often, programs offered by organizations and groups in the community are not part of any broader systemic change effort, nor are they necessarily even coordinated with the schools. The *systemic connections* component describes the relationship between the program and the schools or other larger entity.

Based on the descriptions of the program design and the program in operation (which are well done), the program is performing very well on the set of descriptors that make up the *systemic connections* component. From the onset, the program has existed as part of a larger effort involving five partners, one of which is the Nature Conservancy itself. Planning for the program, as well as its implementation, has been broad-based. It functions as an integral part of the districts' curriculum and is even taught, in part, by the students' classroom teachers. Any problems, such as the university withholding its money and the need for materials that better reflect the cultural diversity of the Borena Valley, appear to be minor and are in the process of being resolved. At least on the aspect of systemic connections, this program is exemplary.

Resource K

Student Enrichment Program: Comparing Three Profiles of the Preparation Component

The following is an example of comparing the profiles of the program design and program in operation with the profile of a quality student enrichment program (Resource C). The example is the *preparation* component, which has been neglected frequently by program designers. A brief commentary on the result of comparing the three profiles follows.

Student Enrichment Program: High School Student Enrichment Program

Profile of a Quality Student Enrichment Program	*Profile of the Program Design*	*Profile of the Program in Operation*
3. Preparation	3. Preparation	3. Preparation
a. Students are oriented to their role and the nature of their experience, to the host organization, and to the sponsor's mission and competencies, using grade-level-appropriate language	a. The host research facility will hold an orientation for students on-site once students have been selected. Parents are invited to come with the students. The orientation will include a tour of the facilities.	a. All students attended the orientation held on May 17th. Just two students did not have at least one parent with them. Dr. Aikens, CEO of the host facility, provided greetings. Program director reviewed the purpose of the student program, how it operates, and what students will learn. Students who participated the previous year and teachers were available to answer questions and to talk with the new students and their parents. Staff members conducted tours of the facilities at the end of the meeting.
b. Program administrator(s), students, teachers, and parents establish mutual expectations in advance	b. This program of student enrichment was originally established with a planning committee of employees from the host facility, teachers, parents, and students. Although membership changes over time, the group reconvenes every spring. At the orientation meeting, the purposes and intended outcomes are reviewed. Parents and students have the opportunity to ask questions, including suggesting changes.	b. At the orientation meeting, some parents and students expressed some concern about the schedule that had the students engaged on Friday, July 5. Many wanted to have a 4-day weekend. Schedule was adjusted so that students could have July 4 and 5 off. Parents were invited to a potluck the last day of the program where they would have an opportunity to see students' work. (This idea evolved during the summer and was not part of the original plan. About three fourths of the students had an adult attend the end-of-program event.)

c. Students receive background materials or orientation in advance	c. Students receive brochures outlining the goals and objectives of the program, along with their application. At the orientation, they will be given brochures describing the mission and purpose of the host facility, along with maps and weekly schedules of program activities.	c. Students received the materials as intended. Because of the change in schedule, however, the program staff had to redo the weekly schedule of events and mail it to students. This year for the first time, students received a reading assignment related to their program 2 weeks before the program began.
d. Students receive advance communication about logistics and housing, when appropriate	d. NA. This is a day, rather than a residential, program. Students take public transportation or drive.	d. NA
e. Program establishes relationship with students' teachers, schools, and/or districts	e. The host facility plans and conducts this student enrichment program jointly with the three high schools in the immediate area. Program staff, teachers, and students serve on a planning committee. One teacher from each high school serves on the program staff each summer. The curriculum supplements that of the high school chemistry and physics classes. In addition, students carry out follow-up work with their classroom teachers after their summer experience has concluded.	e. In late February, the planning committee met to prepare for the 1996 summer enrichment program. The group was made up of three program staff from the host institution, four teachers, two students, and two parents. Two teachers on the planning committee were actually part of the staff for the summer program. They were responsible, in part, for designing follow-up activities for the students to do back in their home schools. They also serve as the liaison between the students and the host institution during the school year.

(Continued)

Student Enrichment Program (Continued)

Profile of a Quality Student Enrichment Program	*Profile of the Program Design*	*Profile of the Program in Operation*
f. Program selects, orients, and trains program staff and associates to ensure that they understand the goals and nature of the program and apply the most appropriate knowledge, skills, attitudes, and strategies to their work with student participants	f. The two teachers who become part of the staff undergo 3 days of training prior to the summer enrichment program beginning. The training includes an orientation to the host institution, e.g., safety procedures, a detailed overview of the curriculum, and planning with program staff for the teaching that they will jointly do during the summer.	f. Training for the two teachers was held just before the orientation. It followed the plan of orienting the teachers to the host facility, reviewing the curriculum, and working with program staff to plan instruction. This year, teachers were able to spend half a day in one laboratory where students will be working.

Commentary: Judging from both the quality and nature of the responses, this is a solid component for a quality student enrichment program. Students are being prepared for their experience, and their parents are actively involved. Moreover, although the program is conducted by a private research facility, the staff work collaboratively with the two high schools in planning the program, recruiting students, orienting students, conducting the program, and providing follow-up. If we assume that these data support other evaluation data from the staff, teachers, students, and parents, this aspect of the program is operating at a high level.

Resource L

Student Enrichment Program: Comparing Three Profiles of the Follow-Up Component

The following is an example of comparing the profiles of the program design and program in operation with the profile of a quality student enrichment program (Resource C). The example is the *follow-up* component, a component of quality programs of several types. A brief commentary on the results of comparing the three profiles follows.

Student Enrichment Program: ChemCom Enrichment Program

Profile of a Quality Student Enrichment Program	*Profile of the Program Design*	*Profile of the Program in Operation*
6. Follow-Up	6. Follow-Up	6. Follow-Up
a. Mechanisms such as newsletters and electronic mail enable communications between students and between students and scientists/mathematicians/technicians; students continue to have access to resources and information of the host organization	a. At the completion of the summer program, students will receive a list of phone numbers and e-mail addresses for host scientists and technicians, and all students and are encouraged to stay in touch with one another. In mid-February, the host institution will hold a "What's Happened Since . . . Day" for students.	a. The list was distributed and used. Scientists and technicians reported hearing from about 5 out of 35 students. The "What's Happened Since . . . Day" was canceled because so few students signed up.
b. Host organization gives students appropriate recognition (e.g., ceremony, awards, T-shirts); host organization encourages recognition by school and district (e.g., press releases, ceremony)	b. Every student will receive a T-shirt. Recognition ceremony will be held at program's end.	b. On first day, each student received a T-shirt that displayed the name of the host and the periodic table. A luncheon at a local restaurant was held for students on the last day. The program director acknowledged students' work and talked to them about careers in chemistry.

c. Host organization provides advice, support, and encouragement for students to share their experience with others and assume leadership roles (e.g., through tutoring, presentations)	c. Host will train students to be judges of elementary school science fairs.	c. One day of the summer program was devoted to training students to be judges of elementary-level science fairs. Students learned how to assess the projects according to a set of criteria. Received a written guide to help them in reviewing projects. Because the follow-up day was canceled, there are no data on how many students actually served as judges.
d. Host organization maintains commitment, contact, and support to students to provide them information on additional opportunities and encourage them to pursue and/or consider science, mathematics, and engineering careers	d. Host will notify students of upcoming events and opportunities that students may be interested in participating in.	d. Students were notified when chemists from Dow Chemical Company came to the host institution. Three came to a lecture and reception.

Commentary: A quick reading of this sample component surfaces some questions and some possible problems. Overall, the host's follow-up program appears to be minimal. Although some activities have potential to support students' experience, they appear to have not been implemented well. For example, training students to be judges in elementary school science fairs has great possibilities. No follow-up was conducted, however, to see which students had the opportunity to judge, what help they needed, or what their experience was like.

Simply distributing a listing of telephone numbers and e-mail addresses will not necessarily result in students staying in contact with scientists or with one another. Generally, they need some reason to do so, such as continuing work on a specific project. Also, simply notifying students of a single event they might be interested in is insufficient. It also appears that the program did nothing to help the schools recognize the students' accomplishments, nor did it actually do much within the program itself.

The quality of descriptions of the program design and the program in operation for this component is also deficient. Some program design descriptions are incomplete and are inauthentic manifestations of the effective practice. Also, description of the program in operation is sometimes short on detail. For example, were the students' accomplishments recognized at the final luncheon, or did the director just talk with the students about career opportunities? An absence of data leads a reader to believe that there was no specific recognition.

In sum, this program has very weak follow-up. The director and staff need to redesign and then actually implement follow-up activities that support and extend students' learning.

Resource M

Systemic Program: Comparing Three Profiles of the Nature of the Partnership Component

The following is an example of comparing the profiles of the program design and program in operation with the profile of a quality systemic program (Resource D). The example is the ***nature of the partnership*** component. A brief commentary on the results of comparing the three profiles follows.

Systemic Program: Urban Systemic Initiative (USI), Metropolitan, USA

Profile of a Quality Systemic Program	*Profile of the Program Design*	*Profile of the Program in Operation*
2. Nature of the Partnership	2. Nature of the Partnership	2. Nature of the Partnership
a. Includes major stakeholders, representing the key groups within the community that are concerned with schools and youths	a. The USI intends to have all major stakeholders (schools, business, community, and parents) as key stakeholders in the systemic initiative.	a. Stakeholders include all key district and schools personnel along with business and community organizations. Representatives from these groups plus the USI staff constitute the urban systemic initiative's management team. Although business and community groups are few in number, they appear to play a major role. The role of parents is unclear. No parents are on the management team. They are expected to participate in the systemic initiative at their children's schools, but that parental involvement role is unclear and appears to be limited.
b. Has a governance and management structure with clearly defined roles, responsibilities, and accountability	b. The governance of this USI is the Aligned Schools in Partnership (ASP), a group made up of the superintendent, central office staff, school-based personnel, business and community partners, and parents.	b. The governance and management of the systemic initiative has been carried out by the ASP, a group made up of the superintendent, central office staff, principals, teachers, business and community partners, plus the USI staff. This group meets once a month and more often if necessary. The group has a written charter outlining roles and responsibilities. Many day-to-day operations of the initiative are carried out by the USI staff. Roles and responsibilities of staff do not always appear to be clearly defined. There are often questions about who is responsible for what and what person can assist if a key person is not available. This is especially true for cross-functional tasks.

c. Has a collaboratively developed strategic plan with sufficient detail for short- and long-term implementation	c. A detailed strategic plan is focused on National Science Foundation drivers. Implementation steps are outlined with specifics as to who will implement what and by when. For each implementation step, indicators are included for assessing how the USI will know when the step has been implemented.	c. The systemic initiative has a strong strategic plan developed by the ASP and honed by the USI staff. This plan, revised annually, appears to be strongly supported by the ASP and the USI staff. The extent to which the strategic plan has accomplished its objectives is discussed elsewhere in this profile. It does, however, appear to be an important and effective driver for decision making.
d. Leverages resources, drawing on strengths of each partner	d. The systemic initiative intends to leverage resources provided by the National Science Foundation, Title I, Eisenhower, and other funding sources to accomplish the greatest good for students and teachers re: reform in mathematics, science, and technology.	d. Through drawing on their Title I and Eisenhower funds, the ASP partners commit to buying materials and providing stipends for teachers attending academies. Schools also provide facilities for conducting the academies, support the lead teachers, provide one computer for every five students, and grant release time for members of the ASP, as necessary.

(Continued)

Systemic Program (Continued)

Profile of a Quality Systemic Program	*Profile of the Program Design*	*Profile of the Program in Operation*
e. Communicates regularly and frequently	e. There is a detailed communications plan for the systemic initiative (see attached copy).	e. The USI has a detailed communications plan carried out by a communications specialist. All partners can communicate electronically, and the USI has just set up a home page. Meetings and conferences are scheduled electronically. Decision minutes are taken at all meetings and sent to all relevant parties. The USI also puts out a monthly newsletter. The communications specialist also operates a hot line that anyone can call to get the latest information on USI happenings.
f. Involves risk taking by all partners	f. Schools take risks through their level of commitment to changing the way they teach mathematics and science. That level of commitment is reflected in their support of the USI vision, mission, and goals.	f. The level of risk taking varies greatly among the schools and especially at the high schools. Many schools are working to have as quickly as possible 100% of their teachers trained to teach high-quality, standards-based mathematics and science. The high schools recently took a major step forward by removing the placement test that personnel had used for screening students into mathematics as incoming ninth graders that resulted in tracking.

g. Each partner commits to the vision and its individual role in achieving it; makes changes in its own institution toward achieving vision	g. The strategic plan calls for all site-based teams in the USI to institutionalize decision-making processes and practices that support full implementation of the unitary program K-12 in mathematics and science. Each school is committed to providing all students access to high-quality, standards-based curriculum.	g. There is some variation among the partners in terms of commitment to the full implementation of the unitary K-12 mathematics and science program. That variation is apparent in the high schools versus elementary schools. The district as a whole and each participating school have identified policies and procedures that either support or impede their implementation of a unitary K-12 curriculum in mathematics and science and either have or are in the process of strengthening supports and weakening or eliminating impediments. The high schools have yet to complete all their policy and procedure revisions.
h. Establishes good working relationships and trust among partners	h. The ASP intends to work together as a collaborative team.	h. Early in its existence, the ASP became aware that they needed additional training to work collaboratively; one of the business partners, ComRax, stepped in to provide that training that has become the basis for their work together. The level of trust between the elementary and high schools has been and remains tenuous because of philosophical differences existing between the two groups.

Commentary: The *nature of the partnership* is a crucial component to any systemic initiative. If the partnership is not functioning well, the initiative is not likely to be successful.

From on the data provided, this partnership appears, on the whole, to be strong. All key stakeholders are involved, with the exception of parents. Roles and responsibilities for the management group, the ASP, are clear, and the group has developed an excellent strategic plan that is guiding its activities. The strategic plan is backed up by a comprehensive communications plan that relies heavily on technology. The USI has been able to invest in technology at the district level through leveraging its resources to support teacher training and materials acquisition at the school level.

Some areas of the partnership may need strengthening. Some role confusion may exist among the USI staff, at least with people who are working with the staff. The USI may want to explore ways of getting more parents involved. Perhaps the most serious problem is the lack of commitment to the vision, mission, and goals and objectives on the part of the high schools. In some instances, the high schools have polarized with their feeder K-8 schools. Symptomatic of this is their not having completed all their policies and procedures revision. The USI should address this lagging commitment before it escalates and possibly spreads to other schools.

Descriptions of the program design and the program in operation are good. They could be strengthened by the addition of a bit more detail.

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